FINAL
FIELD SAMPLING PLAN
ASARCO LLC HAYDEN PLANT SITE
REMEDIAL INVESTIGATION

HAYDEN
GILA COUNTY, ARIZONA

EPA CONTRACT NO. 68-W-98-225
EPA WORK ASSIGNMENT NO. 298-RICO-09JS
CH2M HILL PROJECT NO. 331081/335404

Prepared for
U.S. Environmental Protection Agency
Region IX
75 Hawthorne Street
San Francisco, California  94105

Prepared by
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November 2005
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NOVEMBER 2005

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Plan Title: Draft Field Sampling Plan for ASARCO LLC Hayden Plant Site Remedial Investigation

Site Name: ASARCO LLC Hayden Plant Site

Site Location: Hayden, Arizona

City/State/Zip: Town of Hayden, Gila County, Arizona

Site EPA ID#: AZD008397127


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EPA Remedial Site Manager

Approved: 

EPA Quality Assurance Officer

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EPA Region IX Quality Assurance Reviewer

Approved:
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<td>AAAQG</td>
<td>Arizona Ambient Air Quality Guideline</td>
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<tr>
<td>ADEQ</td>
<td>Arizona Department of Environmental Quality</td>
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<td>ADHS</td>
<td>Arizona Department of Health Services</td>
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<tr>
<td>AGFD</td>
<td>Arizona Game and Fish Department</td>
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<tr>
<td>APP</td>
<td>aquifer protection permit</td>
</tr>
<tr>
<td>ARAR</td>
<td>applicable or relevant and appropriate requirements</td>
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<tr>
<td>ARCH</td>
<td>Air Rotary Casing Hammer</td>
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<td>ARIS</td>
<td>Alternative RCRA Information for States</td>
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<tr>
<td>ATSDR</td>
<td>Agency for Toxic Substances and Disease Registry</td>
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<td>AWQS</td>
<td>Aquifer Water Quality Standards</td>
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<tr>
<td>bgs</td>
<td>below ground surface</td>
</tr>
<tr>
<td>°C</td>
<td>degrees Celsius</td>
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<tr>
<td>CERCLA</td>
<td>Comprehensive Environmental Response, Compensation, and Liability Act</td>
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<tr>
<td>CERCLIS</td>
<td>Comprehensive Environmental Response, Compensation, and Liability Information System</td>
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<tr>
<td>CLP</td>
<td>contract laboratory program</td>
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<tr>
<td>cm³</td>
<td>cubic centimeter</td>
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<td>COCC</td>
<td>chain-of-custody</td>
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<td>COPEC</td>
<td>chemicals of potential ecological concern</td>
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<td>CSDGM</td>
<td>content standard for digital geospatial metal data</td>
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<tr>
<td>CSM</td>
<td>conceptual site model</td>
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<tr>
<td>DO</td>
<td>dissolved oxygen</td>
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<td>DQO</td>
<td>data quality objective</td>
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<td>EPA</td>
<td>Environmental Protection Agency</td>
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<td>EPCRA</td>
<td>Emergency Planning and Community Right-to-Know Act</td>
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<td>ERS</td>
<td>Emergency Response Section</td>
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<td>ESI</td>
<td>expanded site inspection</td>
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<td>FGDC</td>
<td>Federal Geographic Data Committee</td>
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FPXRF  field-portable x-ray fluorescence
FSP  field sampling plan
g  grams
GIS  Geographic Information System
GPS  Global Positioning System
HASP  health and safety plan
HCl  hydrochloric acid
HNO₃  nitric acid
HPLC  high-performance liquid chromatography
HRS  Hazard Ranking System
IDW  investigation derived waste
L/min  liter per minute
LUST  leaking underground storage tanks
MARSSIM  Multi-Agency Radiation Survey and Site Investigation Manual
MC  mass concentration
MCL  maximum contaminant level
mg/kg  milligrams per kilograms
mL  milliliter
mm  millimeters
mph  miles per hour
m/s  meters per second
m³  cubic meters
m³/h  cubic meter per hour
MS  matrix spike
MSD  matrix spike duplicate
MS/MSD  matrix spike/matrix spike duplicate
NAAQS  National Ambient Air Quality Standards
NCP  National Contingency Plan
NOVs  notice of violations
NOD  notice of disposal
NPL  National Priorities List
<table>
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<th>Definition</th>
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<td>National Resources Conservation Service</td>
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<tr>
<td>OERR</td>
<td>Office of Emergency and Remedial Response</td>
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<td>PA</td>
<td>preliminary assessment</td>
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<tr>
<td>PC</td>
<td>personal computer</td>
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<td>PCAMP</td>
<td>pollution control mitigation plan</td>
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<td>PDA</td>
<td>personal digital assistant</td>
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<td>PDOP</td>
<td>position dilution of precision</td>
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<td>PHA</td>
<td>preliminary hazardous analysis</td>
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<tr>
<td>PID</td>
<td>photo-ionization detector</td>
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<td>PM</td>
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<td>PM₁₀</td>
<td>particulate matter 10</td>
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<td>PPE</td>
<td>personal protective equipment</td>
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<td>PSD</td>
<td>prevention of the significant determination</td>
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<td>QA</td>
<td>quality assurance</td>
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<tr>
<td>QA/QC</td>
<td>quality assurance / quality control</td>
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<td>QAPP</td>
<td>quality assurance project plan</td>
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<td>QC</td>
<td>quality control</td>
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<td>R-SRLS</td>
<td>residential soil remediation levels</td>
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<td>RA</td>
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<td>RAP</td>
<td>risk assessment plan</td>
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<td>RCCC</td>
<td>Ray Consolidated Copper Company</td>
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<td>RCRA</td>
<td>Resource Conservation and Recovery Act</td>
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<tr>
<td>RCI</td>
<td>reactivity, corrosivity, ignitability</td>
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<tr>
<td>RI</td>
<td>remedial investigation</td>
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<td>RMS</td>
<td>root mean square</td>
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<tr>
<td>RP</td>
<td>The Ruppereccht and Patashnick Co.</td>
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<td>SAP</td>
<td>sampling analysis plan</td>
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<td>SCS</td>
<td>Supplementary Control Systems</td>
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<td>SD</td>
<td>standard deviation</td>
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<td>SHB-AGRA Earth &amp; Environmental, Inc.</td>
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<td>SI</td>
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<td>Description</td>
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<tr>
<td>SO₂</td>
<td>sulfur dioxide</td>
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<td>SNR</td>
<td>signal to noise ratio</td>
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<td>SVOC</td>
<td>semi-volatile organic compound</td>
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<td>TAL</td>
<td>target analyte list</td>
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<td>The Nature Conservancy</td>
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<td>TOC</td>
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<td>TRI</td>
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<td>total suspended particulate</td>
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<tr>
<td>ug</td>
<td>micrograms</td>
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<tr>
<td>ug/m³</td>
<td>micrograms per cubic meter</td>
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<tr>
<td>um</td>
<td>micrometers</td>
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<tr>
<td>USCS</td>
<td>Unified Soil Classification System</td>
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<td>USFWS</td>
<td>United States Fish &amp; Wildlife Services</td>
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<tr>
<td>UST</td>
<td>underground storage tank</td>
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<tr>
<td>VOA</td>
<td>volatile organic analysis</td>
</tr>
<tr>
<td>VOC</td>
<td>volatile organic compound</td>
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<tr>
<td>WAAS</td>
<td>Wide Area Augmentation System</td>
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<td>XRF</td>
<td>X-ray fluorescence</td>
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Section 1  Objectives

This Field Sampling Plan (FSP) has been prepared to support field and laboratory activities associated with the remedial investigation (RI) for the ASARCO LLC Hayden Plant Site, Hayden, Gila County, Arizona by the U.S. Environmental Protection Agency (EPA). The field activities will include ecological evaluations, geotechnical studies/surveys, well installation, the sampling and analyses of groundwater, surface water, sediment, surficial soils, ambient air, residential attic and indoor dust, and investigation derived waste. This FSP was developed in accordance with EPA Region IX, Guidance for Preparation of a U.S. EPA Region IX, Field Sampling Plan for EPA-Lead Superfund Projects (EPA, 1993 and updates) and accompanies the data quality objectives (DQO), which can be found in the companion Quality Assurance Project Plan (QAPP [EPA, 2005]).

1.1  Background

Following is a general description of the primary Site problems that are the focus of this RI. Additional details are presented in the companion workplan for an RI at the ASARCO LLC Hayden Plant Site (RI Workplan), QAPP and the associated DQO’s. The Site consists of ASARCO’s crushe, concentrator, smelter and tailings deposition. The crushe is located on the north side of Highway 177, south of Hayden. The concentrator operation includes milling operations and two thickener tanks. A crushed ore conveyor, which is approximately 2,000 feet long, has a section that passes over some of Hayden’s streets and directly ore from the crushe to the concentrator operations. ASARCO’s smelting operations are located approximately 2,000 feet east-northeast of Hayden. Tailings from the concentrator operations are transported, as a slurry, to one of two multiple-tier tailings piles (Tailings Pile AB/BC and Tailings Pile D) located south and west of Hayden. Tailings Pile AB/BC is located south of Highway 177 and north of the Gila River, and is approximately two and one-half miles long, one mile wide at its widest point and 200 feet high. Tailings Pile D is located south of the Gila River, parallel to Tailings Pile AB/BC. This pile is approximately two miles long, 1,500 feet wide and 150 feet high.

The operational history of the Site and investigations conducted to date indicate that contaminants (primarily metals) from smelter emissions, crushing and concentrator operations, the tailings piles, process water discharges to unlined ponds, and other process operations have migrated to the air, surface soil, sediments, and groundwater in the Hayden area:

a)  Air: The Arizona Department of Environmental Quality’s (ADEQ) Air Quality Division maintains an air monitoring station in the abandoned Hayden Jail building, about one-half mile west of ASARCO’s smelting operations. The station monitors sulfur dioxide ($SO_2$) and particulate matter smaller than 10 microns ($PM_{10}$) only, and has been in operation since approximately 1969. $PM_{10}$ parameters monitored at the station include arsenic, lead, cadmium, copper, and nickel. $SO_2$ emissions were detected in excess of the National Ambient Air Quality Standards (NAAQS) in 1987, 1988, and 1989. Data from ADEQ’s monitoring station also indicated that the 24-hour Arizona Ambient Air Quality
Guideline (AAAQG) for arsenic was exceeded every year from 1991 to 2000, and the annual AAAQG for arsenic has been exceeded every year since 1991. There is no NAAQS for arsenic, and the AAAQG is not enforced.

b) **Soils**: The analysis of soil samples collected from residential yards in Hayden and Winkelman as part of the Expanded Site Inspection (ESI) and EPA Removal Assessment (RA) showed the presence of arsenic, lead, and copper above Arizona Residential Soil Remediation Levels (R-SRLs). In addition, the concentrations of cadmium, mercury and zinc were greater than three times average background levels in some soil samples *(Expanded Site Inspection Report: ASARCO, Inc., Hayden Plant [ADEQ, 2003] and ASARCO Hayden Removal Assessment: Final Report [Ecology & Environment, 2004])*.

c) **Sediments**: In 1993, a flood washed approximately 292,000 tons of tailings into the Gila River directly from Tailings Pile AB/BC; analysis of the sediment collected adjacent to the tailings piles indicated copper and zinc at concentrations three times the levels detected in background samples. Analysis of river sediment samples were collected as part of the ESI documented arsenic and copper levels above the R-SRLs (ADEQ, 2003).

d) **Groundwater**: Arsenic was detected in groundwater samples collected from monitoring wells located downgradient of containment pond CP-1 at the Site in 1992, at concentrations exceeding the Arizona Aquifer Water Quality Standards (AWQS). Arsenic and cadmium contaminant concentrations exceeding the AWQS were found in groundwater samples from monitoring well SM-2 (located downgradient of CP-1) in 1994 as part of the Aquifer Protection Permit (APP) Supplemental Investigation (SHB, 1994b). Elevated levels of arsenic and cadmium above AWQS were also found in monitoring wells as part of the ESI (ADEQ, 2003). Production wells serving Hayden and Winkelman are completed in the shallow alluvium adjacent to the Gila River and are generally downgradient of Site operations.

Therefore, impacts to air, surface soils, groundwater, and sediments have been documented. Other potentially impacted media include surface water (which may be impacted as a result of runoff from Site areas, tailings ponds, and as a result of impacted river sediments) and dust in residential dwellings.

The main problem at the Site at this time is that the level of risk to community members and the environment is unknown. Additionally, an understanding of the extent of contamination in soil and water, and ongoing in air emissions, is incomplete.

Preliminary Conceptual Site Models (CSM) that outline the primary and secondary sources and release mechanisms, potentially complete exposure pathways and routes, and potential receptors were developed for human and ecological receptors.

Releases from current or historic Hayden smelter and concentrator operations are the primary source of off-Site impacts from the Site. Together, the smelters and concentrator are the source of solid waste releases to soil, fugitive and stack emissions to air, and process wastewater releases. The primary release mechanisms are expected to be spills and releases from on-Site operations, and fugitive and stack air emissions releases. Secondary sources would be on-Site and off-Site soils and groundwater. Potential secondary release mechanisms would be infiltration (leaching and percolation) to groundwater and particulate and dust emissions to ambient air.
Dispersal transport media would include soil, groundwater, surface water, and wind. Potential human exposure routes would include soil (sediment) and dust ingestion, dermal contact, inhalation of particulates and vapors (if any) both indoors and outdoors, tap water ingestion, as well as ingestion of garden vegetables and sport fish caught in the Gila River.

Currently, potential applicable human receptors would be those of Hayden and Winkelman including adult and child residents, school children in schoolyards, pools, and parks, trespassers on tailings piles, and anglers in the nearby Gila River and San Pedro River, as appropriate.

For ecological receptors the primary sources are similar to those described above; namely, current or historic activities of the smelter and concentrator. Primary release mechanisms include air emissions from the smelter stacks and other process locations, as well as solid wastes (tailings) and wastewater associated with the processing of the copper ore. Secondary sources of potential contaminants are surface soils (including the tailings piles or ponds adjacent to the Gila River) and air. Release mechanisms include aerial deposition of stack emissions, discharge/runoff from the tailings piles to the Gila River or to adjacent soils, wind erosion, leaching to groundwater, and surface discharge from groundwater.

Complete exposure pathways from contaminated surface soil, sediment, surface water (including ponded water located on top of the tailings piles), biota, and possibly groundwater, to ecological receptors exist at the Site.

Contaminants in soil may be directly bioaccumulated by terrestrial plants, soil invertebrates, or micro-organisms. Additionally, terrestrial plants may be exposed by uptake from contaminated groundwater or surface water sources or by aerial deposition on to foliage. Aquatic plants are primarily exposed by contaminated sediment. Benthic invertebrates are primarily exposed through sediment and fish and amphibians are primarily exposed through surface water. Terrestrial and aquatic wildlife, including reptiles, may be exposed directly to contaminants in surface water through ingestion and to contaminants in soil or sediment by incidental soil or sediment ingestion, dermal contact, or inhalation of wind-borne particles. Terrestrial and aquatic invertebrates and wildlife (i.e., amphibians, reptiles, birds and mammals) may also receive contaminant exposure through food-web transfer of chemicals from lower trophic levels (e.g., plants to herbivores, plants and prey animals to omnivores, etc.).

For human receptors, the major environmental media associated with offsite exposures to site-related releases are expected to be soil and air, which will be supported by the major focus in sampling for the Site. Groundwater, drinking water, and sediments are expected to be relatively minor sources of risks and hazards, and will receive a comparatively lower level of sampling.

Soil, sediment, and surface water are the primary environmental media for ecological exposures; therefore, the sampling strategy will include samples of these media within areas of ecological habitat. It is unknown at this time whether groundwater is being adversely impacted by the smelter concentrator operations or leaching from the tailings piles; therefore, these pathways will be evaluated with limited sampling.

Several areas of potential concern have been identified.
On-Site Areas:

These areas that are on or adjacent to the Site include:

1. Former Kennecott smelter area;
2. Concentrator operations;
3. Smelter operations;
4. Impoundments, drainage channels and washes;
5. Tailings Pile AB/BC; and
6. Tailings Pile D.

Off-Site Areas:

Areas of potential concern, which are off-Site but may be impacted by Site operations, include:

1. Residential yards and homes in Hayden and Winkelman;
2. Public areas such as schools in Winkelman and playgrounds in Hayden and Winkelman;
3. Gila River and San Pedro River floodplains and environs; and
4. Upland and background areas.

1.2 Objectives

As stated in the RI Workplan, the purpose of the RI is to conduct a multi-media study in the areas of potential concern to identify contaminants, pathways and potential threats to human and ecological receptors. Specific project objectives include:

1. Evaluate Site-related impacts on soils in selected areas;
2. Evaluate Site-related impacts on sediments in impoundments, surface water drainage channels, and the Gila and San Pedro Rivers;
3. Evaluate Site-related impacts on surface water along the Gila River, San Pedro River, and environs;
4. Evaluate Site-related impacts on groundwater quality, and better define groundwater flow conditions, at the Site and study area;
5. Evaluate Site-related impacts on air at the Site and study area;
6. Prepare combined baseline/screening-level Human Health Risk Assessment;
7. Prepare screening-level Ecological Risk Assessment;
8. Identify preliminary remedial alternatives and assess the need for pilot testing; and prepare a comprehensive report of procedures and results.

Site activities to be completed as part of the RI were developed in consideration of existing historic data, which is summarized in Section 1.0 of the RI Workplan. The RI Site activities will include the following tasks:

- **Task 1.** Site reconnaissance for sample and monitoring well location confirmation will include all areas in which field sampling is proposed. The work will consist of
Site surveys including property, boundary, utility rights-of-way, and topographic information.

- **Task 2.** Mobilization and demobilization will be conducted concurrently to the extent possible, but separate mobilizations will likely be required for some activities based on the schedule. The support equipment will vary according to the task being performed. Major activities include:
  - Request and locate utility clearance
  - Mobilization of field personnel for sampling activities
  - Mobilization of subcontractors including drilling operations, waste handlers, and surveyors
  - Arrange for final investigation-derived waste (IDW) removal and Site restoration

- **Task 3a.** Prior to initiating any field work at the Site, CH2MHILL will generate a Site-specific Health and Safety Plan (HASP), Sampling and Analysis Plan (SAP), Pollution Control and Mitigation Plan (PCAMP), and Human Health and Ecological Risk Assessment Plans (RAP). The SAP, HASP, PCAMP, and RAPs will be prepared as companion documents to the RI Workplan prior to initiating any work at the Site.

- **Task 3b.** Surficial Soil Sampling will be focused in areas that have been subject to minimal or no sampling activity in previous investigations. Exceptions include those soil areas where additional chemical data are needed or where changes in soil quality are anticipated to be occurring. The methods employed are:
  - Remote sensing to be done via a fly-over of the Site
  - Gamma ray survey to be done via a walkover of the Site
  - Field portable x-ray fluorescence (FPXRF) to scan individual soil and ore dust fractions of soil samples
  - Soil samples will be obtained by hand digging or hand augering predetermined areas
  - Dust fractions of selected soil samples will be obtained by sieving soil samples through a 200 mesh sieve.

- **Task 3c.** Surface water and sediment sampling will be focused in established waterways and drainages. The area of interest for sediment and surface water sampling is defined as the:
  - Gila River extending from approximately one mile upstream of Winkelman to approximately five miles downstream of Last Chance Basin
  - San Pedro River extending approximately one mile upstream from its confluence with the Gila River
  - San Pedro, Kennecott Avenue, and Power House Canyon Washes
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- Tailings Piles AB/BC and D, which contain standing water
- Stable and unstable riparian communities within the Gila River floodplain
- Upland areas

- **Task 3d.** Groundwater investigation and sampling will include the construction and development of seven new monitoring wells. The groundwater activities are as follows:
  - Groundwater monitoring wells will be installed in six locations (one location will include a two-well nested pair)
  - The Site geologist will maintain a log of conditions encountered during drilling
  - Surveyed locations for all sample points will be acquired either through existing information in the published literature or through field surveying
  - Two comprehensive groundwater sampling events, including selected existing monitoring wells, all new monitoring wells, selected production wells, and selected tap water outlets

- **Task 3e.** Air investigations and dust sampling includes:
  - Installation of several portable/temporary sample collection and meteorological stations that includes all setup of scaffolding sets and data collection/meteorological instrumentation
  - Dust sampling from attics and occupied areas of 10 homes in the Winkelman area and 10 homes in the Hayden area

- **Task 3f.** Ecological investigation that includes a field survey of plant, bird, mammal and aquatic habitat of the study area.

- **Task 3g.** Geotechnical evaluation of tailings piles that includes a review of existing data and a site reconnaissance.

- **Task 3h.** Surveying and mapping, which includes establishing sample locations using both a Global Positioning System (GPS) and land surveyor established coordinates.
Section 2  Site Background

2.1 Site Location and Description

The Site is situated in the town of Hayden, and the study area also includes Winkelman and surrounding areas along State Highway 177 in both Gila and Pinal Counties, Arizona. Generally, the Site is concentrated within several sections of Township 5 South, Range 15 East. Hayden is located approximately 100 miles southeast of Phoenix and 50 miles northeast of Tucson, Arizona. Winkelman is located approximately one mile southeast of Hayden. Figure 3-1 shows the general location of the Site; Figure 3-2 shows the arrangement of residential, commercial, and industrial facilities; drainage patterns; and definition of the overall areas of potential concern.

Hayden has a population of approximately 900 residents (Arizona Department of Commerce, 2005). ASARCO operations including the active smelter, former Kennecott smelter, crushing, milling, concentrator, and tailings piles surround the Hayden community on the northern, southern and eastern edges of town. Residential areas are confined on the west edge of town by the San Pedro Wash, and are bisected by Kennecott Avenue Wash. Public areas including a playground and swimming pool are located adjacent to and west of ASARCO’s concentrator facilities.

Winkelman has a population of approximately 450 people (Arizona Department of Commerce, 2005). It is primarily a residential area, with a school complex on the north edge of town, commercial development along State Highway 177, and a community park along the Gila River on the east edge of town.

ASARCO’s overall process operations area includes the No. 9 conveyor extending from the crusher facilities on the north side of State Highway 177 to the concentrator facilities on the east edge of the residential areas (the final length of the conveyor is overhead), active smelting operations approximately one-half mile northeast of the town, a former Kennecott smelter area on the north edge of town and north of the concentrator complex, a tailings slurry pipeline extending from the concentrator to Tailings Pile AB/BC and Tailings Pile D located adjacent to the Gila River, and process/storm water management facilities (ADEQ, 2003). Although closely related, ASARCO manages the concentrator and smelter operations separately, and each has a separate entrance. The active smelter is approximately 11 stories tall, and treated air emissions are released to the atmosphere through a 1,000 foot tall stack. Slag from active smelter operations is deposited in a dump located immediately southeast of the smelter. The former Kennecott smelter area was recently subject to demolition work, which consisted of miscellaneous building debris, storage tanks, foundations, and an abandoned slag dump northwest of the former smelter; the former and inactive Kennecott smelter stack was not subject to demolition activity (ASARCO, December 15, 2004).

Tailings Pile AB/BC is located south of State Highway 177 and north of the Gila River; extending for a length of approximately two and one-half miles, maximum width of one mile, and height of 200 feet. Tailings Pile D is located south of the Gila River; extending for a
length of approximately two miles, maximum width of 1,500 feet, and height of 150 feet. Process/storm water management facilities consist of multiple small surface water impoundments located throughout the concentrator and smelter areas, Power House Canyon Wash (bisecting the active smelter area and concentrator/Hayden residential areas), retention ponds located south-southeast of Tailings Pile AB/BC, a large retention pond (Last Chance Basin) at the northwest edge of Tailings Pile AB/BC, and containment berms in selected areas.

Hayden’s drinking water is supplied by a well field located south of Hayden, east of Tailings Pile AB/BC, and west of Winkelman. Winkelman’s water is supplied by two wells located east of town within the community park adjacent to the Gila River (ADEQ, 2003).

2.2 Operational History

The operational history of the ore processing operations in the Hayden-Winkelman area is described in several sources, including recent reports on investigations of multi-media contamination in the area. The Ray Mine has been mined for copper since approximately 1880. One of the first owners of the mine was Ray Copper Company. This company transitioned to Ray Consolidated Copper Company (RCCC) with the acquisition of Globe Mines Exploration Company, Ltd. and Gila & Ray Copper Mines in 1898 and 1906, respectively. During this period, the towns of Winkelman and Hayden were founded. Winkelman was founded in 1887, and Hayden was founded in 1909 as a company town to provide housing for workers supporting the mining and smelting operations (EPA, 2004a). ASARCO constructed its Hayden smelter in 1911 and began operations to process ore from the Ray Mine in 1912. In 1933, Kennecott Copper Company (Kennecott) bought the Ray Mine from RCCC. The ASARCO Hayden smelter stopped receiving ore from Ray Mine in 1958, at which time Kennecott began operation of its Hayden smelter. The Kennecott smelter was shut down in 1982, and selected structures are currently undergoing demolition by ASARCO.

ASARCO completed modernization of its Hayden smelter in 1983; including installation of an oxygen flash smelting furnace, construction of an oxygen plant to produce oxygen for the new furnace, construction of a second sulfuric acid plant to capture and re-use SO₂ emissions produced during smelting, and construction of a wastewater treatment plant to recover process water from the sulfuric acid plant for re-use. ASARCO’s smelter renewed processing of ore from the Ray Mine in 1983, and ASARCO bought the Ray Mines Division from Kennecott in 1986. The Ray Complex was created from control of both the mine and processing operations. In 1996, the Hayden concentrator modernization was completed (ADEQ, 2003).

In the current operations, sulfide ore is transported from the Ray Mine and off-loaded at the track hopper into the crusher facility. Crushed ore is transported by a conveyor to the concentrator, where the ore is milled, mixed with a chemical solution, and aerated. The copper concentrates created from this process are transported to the smelter for further processing (the smelter also receives concentrates directly from the Ray Mine operations). The tailings waste is transported as slurry to be deposited on Tailings Piles AB/BC and D. The concentrates transported to the smelter are unloaded and blended with fluxes, then transferred to fluid bed dryers where they are dried and stored prior to being introduced.
into the oxygen flash furnace and subsequently, converter furnaces to produce 98.5 percent pure copper. Copper is further processed in anode furnaces to produce copper anodes that are 99 percent pure. The anodes are shipped off-Site for final processing (ADEQ, 2003).

During the smelting process, sulfur from the ore is oxidized to form \( \text{SO}_2 \) gas, which is converted to sulfuric acid in the sulfuric acid plant. Slag from the smelter operations is transferred to stockpiles located southeast of the smelter operations area. Treated wastewater and other process waters are discharged to containment pond CP-1, located east of the smelter. Decant water from the tailings piles is discharged to retention ponds located east of Tailings Pile AB/BC, where it is reclaimed into the process operations (ADEQ, 2003).

2.3 Physical Description

A detailed physical description of the Site topography and drainage, surface water hydrogeology, terrestrial and aquatic systems, geology, and hydrogeology can be found in the companion RI Workplan (CH2M HILL, 2005).

2.4 Previous Investigations and Regulatory Involvement

Previous Investigations

Previous investigations at the Site have been conducted by EPA and ADEQ (including primarily the Air Quality Division and the Water Quality Division). In addition, the Arizona Department of Health Services (ADHS) joined with the Agency for Toxic Substances and Disease Registry (ATSDR) to prepare a Public Health Assessment (ADHS and ATSDR, 2002). ASARCO has led investigations relating to leaking underground storage tanks (LUST) and other compliance-related matters at the Site. The following summarizes the major investigations at the Site:

1. In 1988, EPA contracted with Ecology & Environment to conduct a Preliminary Assessment (PA) and Evaluation of the Site using the Hazard Ranking System (HRS) scoring. The HRS assesses the relative threat associated with actual or potential releases of hazardous substances at the Site. The HRS was adopted by EPA to help set priorities for further evaluation and eventual remedial action at hazardous waste sites. The HRS is the primary method of determining a site’s eligibility for placement on the National Priorities List (NPL). The NPL identifies sites at which EPA may conduct remedial response actions. Following this PA, a Screening Site Inspection (SI) was recommended for the Site.

2. In 1991, ADEQ conducted a non-sampling SI and concluded that based on documented releases to the air and soil, the Site qualified for further consideration under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) regulations (ADEQ, 1991).

3. In January 1989, ASARCO removed a 1,000-gallon gasoline underground storage tank (UST) and a 1,000-gallon diesel UST located southwest of its smelting operations. During the removal, holes in the tanks and evidence of a release were noted. ASARCO installed and operated a soil vapor extraction system at the site of the gasoline release and
initiated a quarterly groundwater monitoring and product removal program at the diesel release site. ASARCO is in the process of closing both UST sites (Hydrometrics, 1998).

4. In September 1998, during the removal of two 5,000-gallon gasoline USTs located near the concentrator operations, holes in the USTs were noted and a gasoline release was reported. Contaminated soil was excavated and removed from the UST location. ASARCO is in the process of closing this UST site. According to ADEQ’s UST Corrective Action Section, groundwater contamination is not known to be related to the LUST releases at this Site (Hydrometrics, 1998).

5. In 1999, ADHS conducted a preliminary hazardous analysis (PHA) for the study area, which consisted of obtaining environmental samples within Hayden and Winkelman to determine both background levels of metals and area levels of these metals. From June to October 1999, the University of Arizona conducted public health surveys of the residents of Hayden and Winkelman. Blood lead levels were evaluated for children 6 to 36 months and for some children up to 72 months of age and urinary arsenic levels were checked in adults and children. All test results were presented to the participants along with recommendations to seek follow-up care if levels were elevated above the standards used for this study. On March 16, 2000, findings of the health survey were presented during two meetings in Hayden and Winkelman with local residents. In 2002, ADHS presented the draft report for public comment and subsequently issued the final report. Conclusions of the report state that outdoor air in the Hayden and Winkelman area meets all federal and state air quality standards for criteria air pollutants including SO2. Brief episodes of elevated SO2 in air may cause short-term respiratory symptoms for sensitive asthmatics a few times per month. Levels of SO2 in air are unlikely to cause respiratory symptoms in persons without pre-existing respiratory conditions. Exposures to water and soil pose no apparent public health hazard. The report noted, however, that conclusions drawn were based on data available at the time the document was released, and that conclusions could change if data indicate that exposure has increased or decreased based on further environmental investigation (ATSDR, 2002).

6. In 2000, EPA contracted Ecology & Environment to review Site information and previously collected sampling data, to determine additional data needs, to recommend sampling to gather necessary data, and to develop a workplan to conduct the recommended sampling. Ecology & Environment determined additional data would be required for HRS scoring to adequately document the soil, groundwater, and surface water exposure pathways associated with the Site. Wind-blown dust from tailings piles, smelter smoke stack emissions, and dust from operation of the overhead conveyor belt in Hayden were all identified as potential sources of contamination associated with ASARCO operations. Soil sampling in the towns of Hayden and Winkelman was recommended (ADEQ, 2003).

7. In 2002, ADEQ performed an ESI, which included sampling around the ASARCO operations in and near Hayden. During the ESI, ADEQ collected surface soil samples from 23 private residences located in Hayden. Elevated levels of arsenic, cadmium, copper, mercury, and lead in surficial soil in both residential and public areas in Hayden were found, as well as from sampling locations in Kennecott Avenue Wash and Power House Wash. The residential areas were sampled due to the potential for the finer
material on the conveyor belt that runs through town to be dispersed by wind into the residents' yards. Surface soil sampling locations at the private residences were divided into two priority areas: Priority One Area included the private residences to the east of ASARCO's conveyor belt, located on Smelter Road, Hillcrest Avenue, and Sunnyslope Road. Priority Two Area included the private residences located to the west of the conveyor belt, and on Ray/Velasco and Garfield Avenues. Surface soil samples were also collected from locations near the conveyor belt to determine if materials that fall off the conveyor belt are also a source of contamination (ADEQ, 2003).

8. In 2004, the EPA Emergency Response Section (ERS) under the authority of CERCLA, contracted Ecology & Environment to perform additional sampling in the Hayden area to determine if levels of metal contaminants contained in the soil resulted from ASARCO operations. Analytical results from this RA effort document areas with concentrations of copper, lead, and arsenic above their respective R-SRLs (Ecology and Environment, 2004).

In addition to the above investigations, ADEQ's Air Quality Division maintains an air monitoring station in the abandoned Hayden Jail building, which is located approximately one-half mile west of ASARCO's smelting operations. The station monitors SO₂ and PM₁₀ only, and has been in operation since approximately 1969. PM₁₀ parameters monitored at the station include arsenic, lead, cadmium, copper, and nickel. SO₂ emissions were detected in excess of the NAAQS in 1987, 1988, and 1989. Data from ADEQ’s monitoring station also indicated that the 24-hour AAAQG for arsenic was exceeded every year from 1991 to 2000, and the annual AAAQG for arsenic has been exceeded every year since 1991. There is no NAAQS for arsenic, and the AAAQG is not enforced. In addition to the ADEQ air monitoring station, as a requirement of the air permits for the facility, ASARCO maintains ambient air monitoring stations at various locations in the Hayden area. These stations are located at the abandoned Hayden Jail, Globe Highway, Hayden Junction, Montgomery Ranch, and Garfield Avenue.

Background information is summarized in the companion document “Final Workplan – Remedial Investigation at the ASARCO LLC Hayden Plant Site, Hayden, Gila County, Arizona” (Workplan). Section 2.8 of the Workplan provides a more detailed summary of the 2004 ERS results. For completeness, the following details are from the Workplan and will be included at the end of Section/Item# 8 on Page 2-5 of the FSP:

Soil samples were collected at a total of 69 locations in Winkelman and 51 locations in Hayden. Surficial samples were collected to depths of approximately two inches bgl and submitted for laboratory analyses of TCLP and total metals. The TCLP results for the samples collected in Winkelman and Hayden did not reveal concentrations above the TCLP limits. Of the 69 samples from Winkelman, the total metals analyses revealed the following primary exceedances of R-SRLs in surficial soils:

- Arsenic levels exceeded the R-SRL of 10 mg/kg at 16 locations;
- Copper levels exceeded the R-SRL of 2,800 mg/kg at seven locations; and
- Lead levels exceeded the R-SRL of 400 mg/kg at three locations.

Of the 51 samples in the Hayden area, the total metals analyses revealed the following primary metals above R-SRLs at 40 locations including the following:
• Arsenic levels exceeded the R-SRL of 10 mg/kg at 40 locations;
• Copper levels exceeded the R-SRL of 2,800 mg/kg at 29 locations; and
• Lead levels exceeded the R-SRL of 400 mg/kg at one location.

Sample locations revealing elevated copper and lead concentrations generally coincided with locations showing high arsenic concentrations, with the highest concentrations typically concentrated close to ASARCO facilities, including particularly the No. 9 conveyor belt. Analyses of background samples revealed that concentrations of metals above their respective R-SRLs are not naturally occurring. The RA concluded that surficial soil contamination is present in Hayden and Winkelman. The study further concluded that the elevated concentrations of metals found throughout Hayden are likely the result of contamination dispersed from ASARCO operations. Elevated concentrations of metals in Winkelman are presumed due to the close proximity to ASARCO operations (exceedances in the northern portion of town), and proximity to tailings disposal areas, and aerial dispersion for vehicles traveling along State Highway 177, as well as rail transport facilities for copper ore (exceedances in the southern portion of town).

Regulatory Involvement
Both EPA and ADEQ have been involved with this Site from a regulatory standpoint. The Site was identified as a potential hazardous waste site and entered into the Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) on December 1, 1979 and was given EPA ID No. AZD008397127. The Site is listed as a “Large Quantity Generator” in the Alternative Resource Conservation and Recovery Act (RCRA) Information for States (ARIS) database.

ASARCO maintains two ADEQ Air Quality Class I (Major Source) operating permits for its Hayden operations: one for the concentrator (Permit Number M070399P1-99) and one for the smelter (Permit Number 1000042). ADEQ has performed numerous inspections at the Site. As a result of these inspections, numerous Notice of Violations (NOVs) have been issued to ASARCO, primarily in the 1990s. Most of the NOVs were issued to ASARCO for observed emissions from the smelter stack with opacities greater than 20 percent. A NOV was also issued in March 1991 for an observed release of dust from AB/BC Tailings Pile with opacity of 78 percent (ADEQ, 2003).

In 1985, a Notice of Disposal (NOD) for discharging wastewater was filed with ADHS, the predecessor of ADEQ. The NOD outlines all wastewater discharges from ASARCO’s Hayden operations. Included in the NOD, untreated domestic sewage, along with the tailings slurry from the concentrator operations, is discharged over the top of the tailings piles. ASARCO was also discharging wastewater sludge, from the treatment of the smelter scrubber blowdown, to a lined impoundment south of the smelter (ADEQ, 2003).

In 1985, a Notice of Disposal (NOD) for discharging wastewater was filed with ADHS, the predecessor of ADEQ. The NOD outlines all wastewater discharges from ASARCO’s Hayden operations. Included in the NOD, untreated domestic sewage, along with the tailings slurry from the concentrator operations, is discharged over the top of the tailings piles. ASARCO was also discharging wastewater sludge, from the treatment of the smelter scrubber blowdown, to a lined impoundment south of the smelter (ADEQ, 2003).

ASARCO filed two APP Applications with ADEQ’s Water Permits Section. The first application for an APP was submitted to ADEQ in 1992. A second application was filed in 1995 due to deficiencies noted in the 1992 application. To date, the 1995 application is still under ADEQ review. According to the ADEQ Mining Unit Manager, the application is currently in the technical review process, and the effort is focused at this time on the Ray
portion of the Ray/Hayden Complex. Until the APP Application is approved, it is ADEQ’s understanding that ASARCO will continue to operate under the guidelines of the NOD. According to ADEQ’s APP Mining Unit, no current enforcement actions have been issued for the Site (ADEQ, 2004).

Twenty-seven (27) spill incidents have been documented at the Site from October 1990 to September 2002 according to the National Response Center database. Land was the most affected medium. The spilled materials included sulfuric acid, arsenic acid, arsenic compounds, cadmium compounds, and lead compounds. According to ADEQ's Hazardous Materials Incident Logbook, no emergency response actions occurred (ADEQ, 2005).

2.5 Summary of Existing Data

Section 2.8 of the RI Workplan provides a summary of existing Site characterization data for soils, sediments, surface water, groundwater, and air.

2.5.1 Available Soil Quality Data

The Hayden-Winkelman area has been subject to multiple investigations of surficial soil quality in recent years. These investigations were components of a broad effort by EPA and ADEQ to identify and address environmental impacts associated with the Site. Investigations of surficial soils have yielded data that are useful in determining risk of exposure to residents of Hayden and Winkelman from concentrations of metal contaminants in soil.

Investigations of contaminant concentrations in surficial soils have included, in chronological order, the following:

1. A non-sampling SI was performed by ADEQ in 1991. The SI concluded that the Site qualified for further evaluation under CERCLA (Ecology and Environment, Inc., 2004).

2. Ecology & Environment, Inc. (under contract to EPA) performed a data review in 2000. From that review, a recommendation was made for further soil, groundwater, and surface water contaminant characterization to better document exposure pathways (Ecology & Environment, Inc., 2004).

3. An ESI was performed by ADEQ in 2002. The project involved sampling of surficial soils and other media in the vicinity of ASARCO operations in and near Hayden to document levels of metals in residential and public locations (ADEQ, 2003).

4. The ASARCO Hayden RA was performed by Ecology & Environment, Inc. (under the direction of the EPA Emergency Response Section) in 2004. This work involved sampling of surficial soils only in residential areas of Kearny, Hayden, and Winkelman to determine levels of metal contaminants resulting from ASARCO operations (Ecology & Environment, Inc., 2004).

5. Sampling of surficial soils in selected school and playground areas in Winkelman and Hayden was completed by EPA in 2004, with the same purpose as the RA. These data were provided by EPA, but were not included in a previously published report.
The last three investigations cited above, which included collection of surficial soil samples, provide the basis for information included in this data summary section. The scope, results, and conclusions from each of these three investigative efforts are summarized in the companion RI Workplan (CH2M HILL, 2005).

### 2.5.2 Available Groundwater Quality Data

This section summarizes available groundwater quality data from monitor wells and production wells in the Hayden and Winkelman areas. The Hayden well field is operated by ASARCO and consists of 19 production wells (ASARCO, January 20, 2005). The Winkelman well field is operated by the Arizona Water Company and consists of two active production wells. Additionally, ASARCO maintains a network of monitoring wells in the study area.

Fourteen (14) separate rounds of groundwater sampling have been reported in the recent past for the monitoring wells and water supply well fields located in the vicinity of the Hayden site. Sampling of a limited number of wells was conducted during each event. Nine sampling events were performed as part of the APP Part III application (July 1992 through June 1993) (SHB, 1994a), four sampling events were performed as part of the APP Supplemental Investigation (February 1994 through November 1994) (SHB, 1994b), and one sampling event was performed as a part of the ESI (May 2002 through June 2002) (ADEQ, 2003). Based on the Site visit/meeting of December 15, 2004, ASARCO also conducts quarterly groundwater monitoring; however, these data were not available prior to development of this document.

Summary data of all maximum contamination level (MCL) exceedances, which have included arsenic, cadmium, chromium, copper, lead, and mercury, are contained in Table 2-5 of the RI Workplan (CH2M HILL, 2005).

Overall, the surface water and sediment sample results exceeded results from the single upgradient sample location, and indicate likely impacts from the Hayden plant operations. Additional background data will be collected during the RI.

### 2.5.3 Available Surface Water and Sediment Quality Data

A review of historical documents was conducted to summarize surface water and sediment quality data. Surface water and sediment samples were collected once in 1993 following a tailings spill event and during the ESI in 2002 (ADEQ, 2003). The 1993 sediment sampling event was used to document a spill of an estimated 292,000 tons of copper mine tailings that washed into the Gila River on January 17, 1993 (ADEQ, 1993). Six sediment samples were collected from the Gila River; including one near the town of Winkelman, upstream of the railroad bridge; two adjacent to the tailings near the Gila River; one five miles downstream; one seven miles downstream; and one sample from Kelvin, approximately 11 miles downstream. The sample results indicated an increase in zinc and copper concentrations in sediment downstream of the tailings spill. Soluble solids and leachable sulfate concentrations also increased downstream of the tailings discharge. The ESI identified the potential for fines from the conveyor belt and other fugitive sources, sediment from the tailings pile, and particulates from the smelter stack to disperse throughout the stretch of the Gila River that spans the Site and the area downgradient of the Site. Therefore, sediment samples were collected from the Gila River, San Pedro River, Power House Canyon Wash,
and Kennecott Avenue Wash. Samples were also collected from containment pond CP-1 (formerly Louie’s Lagoon), Tailings Pile AB/BC, Tailings Pile D, and the storm water pond. Samples from these locations are considered non-river sediment samples, and are discussed in Section 2.5.4. A total of 15 river/wash sediment samples were collected from the Hayden area during the ESI; this total includes 12 from the Gila River, one from the San Pedro River, one from Power House Canyon Wash, and one from Kennecott Avenue Wash. A total of 20 surface water samples were collected from nine locations along the Gila River. Surface water samples were collected from locations along the Gila River only, as the San Pedro River, Power House Canyon Wash, and Kennecott Avenue Wash were dry at the time of sampling activities.

The sediment samples were collected as close as possible to their corresponding surface water samples. The sediment and surface water samples were analyzed for total metals. In addition, surface water samples were also analyzed for general water quality parameters, including chloride, sulfate, fluoride, nitrate, nitrite, total Kjeldahl nitrogen, hardness, alkalinity, total dissolved solids (TDS), and total suspended solids (TSS).

In the ESI, arsenic and copper were the two primary metals detected above the Arizona R-SRLs (10 milligrams per kilogram [mg/kg] for arsenic and 2,800 mg/kg for copper) in the sediment samples. Arsenic in sediment samples ranged from 1.9 mg/kg (sample AHP-GR-SD-04 collected from the Gila River) to a maximum of 33.4 mg/kg (sample AHP-KC-SD-01 from the Kennecott Avenue Wash). Two samples met the criteria for “elevated concentration” for arsenic (AHP-PC-SD-01 from Power House Canyon Wash and AHP-KC-SD-01 from Kennecott Avenue Wash) but, did not have arsenic concentrations above the Arizona R-SRLs. The average background concentration for arsenic is 4.95 mg/kg.

Copper concentrations in sediment samples ranged from 14.9 mg/kg (sample AHP-GR-SD-09 from the Gila River) to 14,000 mg/kg (sample AHP-KC-SD-01 from Kennecott Avenue Wash). Two samples met the criteria for “elevated concentration” for copper (AHP-PC-SD-01 from Power House Canyon Wash and AHP-KC-SD-01 from Kennecott Avenue Wash) but, did not have copper concentrations above Arizona R-SRLs. The average copper background concentration is 74.9 mg/kg.

Cadmium, chromium, lead, mercury, and zinc were detected at concentrations below Arizona R-SRLs (38 mg/kg for cadmium, 2,100 mg/kg for chromium, 400 mg/kg for lead, 6.7 mg/kg for mercury, and 23,000 mg/kg for zinc) in all sediment samples from the ESI. The maximum cadmium concentration was detected in samples AHP-KC-SD-01 from Kennecott Avenue Wash. Two sediment samples (AHP-KC-SD-01 from Kennecott Avenue Wash and AHP-PC-SD-01 from Power House Canyon Wash) met the criteria of “elevated concentration” but, were below Arizona R-SRLs. The average background cadmium concentration is 0.42 mg/kg.

The maximum chromium concentration was 31.5 mg/kg in sample AHP-PC-SD-01 from Power House Canyon Wash. This sample was the only one to meet the criteria of “elevated concentration” for chromium. The average chromium background concentration is 9.7 mg/kg.

Lead was detected at a maximum concentration of 127 mg/kg in sample AHP-PC-SD-01 collected from Power House Canyon Wash. Two samples (AHP-PC-SD-01 from Power
House Canyon Wash and AHP-KC-SD-01 from Kennecott Avenue Wash) met the “elevated concentration” criteria for lead. The average lead background concentration is 14.3 mg/kg.

The maximum mercury concentration detected in sediment samples was 0.23 mg/kg in sediment sample AHP-KC-SD-01 collected along Kennecott Avenue Wash. Sample AHP-KC-SD-01 also met the criteria of an “elevated concentration” for mercury. The average background concentration for mercury is 0.1 mg/kg.

Zinc was detected at a maximum concentration of 469 mg/kg in sediment sample AHP-PC-SD-01 from Power House Canyon Wash. This sample also met the criteria of “elevated concentration” for zinc. The average background concentration for zinc is 60.7 mg/kg.

Overall there is insufficient non-river sediment data available to conclusively determine background concentrations for metals of concern in the study area. Therefore, the Workplan call for the collection of 13 background non-river sediment samples distributed across the study area.

### 2.5.4 Available Non-River Sediment Quality Data

In addition to sediment samples from the rivers and drainage washes in the Hayden area, non-river sediment samples were collected as well during the ESI (ADEQ, 2003). These non-river sediment sample locations include the containment pond CP-1, the storm water pond located upgradient from CP-1, Tailings Pile AB/BC, and Tailings Pile D. A total of 10 non-river sediment samples were collected during the ESI; two from CP-1, three from Tailings Pile AB/BC, three from Tailings Pile D, and two from the storm water pond.

CP-1 sediment samples were collected from the southwest corner of the containment pond, which is the location of the concrete lined sump. This sump was considered to be a potential contaminant source. Sediment samples collected from the storm water pond were collected as background samples since this pond is located upgradient of CP-1. Sediment samples collected from the two tailings ponds were located to evaluate if the tailings piles are a source of any mining related contaminants that might be detected in the water and/or sediment samples collected from the Gila River.

Arsenic, cadmium, copper, lead, and mercury each exceeded R-SRLs in one or more of the non-river sediment samples collected during the ESI. Chromium and zinc were the two target compounds that were not detected at concentrations above R-SRLs in any non-river sediment samples; however, chromium and zinc concentrations did exceed average background levels. The maximum chromium concentration was 59.1 mg/kg from sediment sample SU-SD-01, collected from CP-1. The average background concentration for chromium is 9.7 mg/kg. Sediment samples TPD-SD-01, TPD-SD-02, TPD-SD-03 (all collected from Tailings Pile D), TPA-SD-03 (collected from Tailings Pile AB/BC, SU-SD-01 and its duplicate (collected from CP-1) meet the criteria of “elevated concentration” for chromium. Zinc concentrations in the non-river sediment samples ranged from 88.3 mg/kg in sample TPA-SD-02 (collected from Tailings Pile AB/BC) to 7,110 mg/kg in sample SU-SD-01 (collected from CP-1). The average background concentration for zinc is 60.7 mg/kg and all samples except TPA-SD-02 (collected from Tailings Pile AB/BC) meet the criteria of “elevated concentration” for zinc.
Arsenic concentrations in the non-river sediment samples ranged from 4.8 mg/kg in sediment sample TPA-SD-02 (collected from Tailings Pile AB/BC) to 4,960 mg/kg in sediment sample SU-SD-02 (field duplicate collected from CP-1). Six non-river sediment samples exceeded the R-SRL for arsenic of 10 mg/kg. The average background concentration for arsenic is 4.95 mg/kg, and four samples, SU-SD-01 & 02, its duplicate (both collected from CP-1), SP-SD-01 (collected from storm water pond), and SP-SD-02 (also collected from storm water pond) meet the criteria of “elevated concentration” for arsenic.

Cadmium concentrations in the non-river sediment samples ranged from 1.1 mg/kg in sediment sample TPA-SD-02 (collected from Tailings Pile AB/BC) to 722 mg/kg in sediment sample SU-SD-02 (collected from CP-1). Two non-river sediment samples exceeded the R-SRL for cadmium of 38 mg/kg. The average background concentration for cadmium is 1 mg/kg, and four samples, SU-SD-01 & 02, its duplicate (both collected from CP-1), SP-SD-01 (collected from storm water pond), and SP-SD-02 (also collected from storm water pond) met the criteria of “elevated concentration” for cadmium.

Copper concentrations in the non-river sediment samples range from 502 mg/kg in sediment sample TD-SD-01 (collected from Tailings Pile D) to 95,800 mg/kg in sediment sample SU-SD-01 (collected from CP-1). Four non-river sediment samples exceeded the R-SLR for copper of 2,800 mg/kg. The average background concentration for copper is 74.9 mg/kg, and all of the sediment samples met the criteria of “elevated concentration” for copper.

Lead concentrations in the non-river sediment samples range from 12.1 mg/kg in sediment sample TPA-SD-02 (collected from Tailings Pile AB/BC) to 9,750 mg/kg in sediment sample SU-SD-02 (collected from CP-1). Two samples exceeded the Arizona R-SLR for lead of 400 mg/kg. The average background concentration for lead is 14.3 mg/kg, and sediment samples SP-SD-01, SP-SD-02 (both collected from storm water pond), TPD-SD-03 (collected from Tailings Pile D), TPA-SD-03 (collected from Tailings Pile AB/BC), and SU-SD-01 and its duplicate meet the criteria of “elevated concentration” for lead.

Mercury concentrations in the non-river sediment samples range from non-detect to 808 mg/kg in sediment sample SU-SD-02 (collected from CP-1). Two samples exceeded the R-SRL of 6.7 mg/kg for mercury. The average background concentration for mercury is 0.1 mg/kg. SP-SD-01 (collected from storm water pond) and SU-SD-02 (collected from CP-1) and its duplicate meet the criteria of an “elevated concentration” for mercury.

2.5.5 Available Air Quality Monitoring Data

Since the early 1970s, the EPA, State of Arizona (State), and ASARCO have collected ambient air monitoring data for SO₂ and PM₁₀ at various locations in the Hayden area. Selected PM₁₀ samples have also been analyzed for elemental compositions. The following sections provide a summary of available air quality monitoring data. This summary is not an exhaustive listing of all available data, but is included to show the nature and concentration of pollutants in the ambient air in the Hayden area.

ASARCO submits annual discharges of toxic chemicals to EPA under the Federal Emergency Planning and Community Right-to-Know Act (EPCRA) program to inform communities and citizens of chemical hazards in their areas. Through EPCRA, Congress
mandated that information on toxic chemical releases to the environment be collected into a database called the Toxic Release Inventory (TRI). The information submitted by ASARCO includes the releases to the air from slag dumping, smelter emissions and dust from crushing ore. The ASARCO copper smelter in Hayden has been one of the top releasers of TRI chemicals in the entire nation.

ASARCO also submits annual emission inventory of regulated air pollutants to ADEQ as a requirement of regulations adopted by State of Arizona and EPA under the Clean Air Act.

**SO2 Monitoring Network**

Monitoring began in the Hayden area in 1970 by the State (Hayden Sulfur Dioxide Nonattainment Area State Implementation and Maintenance Plan, ADEQ, June 2002). ASARCO began continuous ambient SO2 air quality monitoring in the Hayden area in 1974. Since that time, an extensive monitoring network was established with spatial and temporal coverage intended to comprehensively evaluate the ambient impact of smelter emissions. More than 20 stationary and mobile monitoring sites were established throughout the area with as many as 12 monitors operating concurrently. This ambient SO2 network, comprised of EPA, State, and ASARCO monitors, was developed as the result of extensive efforts to identify maximum ambient impact areas using diffusion modeling, monitored atmospheric dispersion parameters, citizen observations, and ambient SO2 monitoring.

Installation of additional meteorological instrumentation at the network sites, measuring wind speed and direction, air temperature, and humidity parameters, helped to further define airflow and pollutant transport in the region. Utilization of mobile monitors allowed evaluation and verification of ambient SO2 concentrations over a greater area. Numerous sites were monitored and subsequently relocated under the direction of State meteorologists when no significant impacts were observed. All monitoring for SO2 was reportedly performed with guidance and dispersion modeling analysis from ADEQ.

The monitoring network was also developed in accordance with Supplementary Control Systems (SCS). Prior to implementation of continuous control technology, SCS utilized analysis of atmospheric conditions and monitored ambient concentrations to vary the rate of smelter emissions to avoid any exceedance of NAAQS. In 1977, the State adopted rules that codified requirements for concurrent operation of at least eight ambient monitors, including a mobile monitor placed at points representative of observed maximum concentrations.

Following ASARCO’s compliance with emissions limits as defined in Arizona Administrative Code R18-2-715(F), and based on continuous control technology, the number of permanent monitors was gradually reduced to the current network of six. These are all high impact ambient monitoring sites considered to be generally representative of air quality for the area. These monitoring site decisions were made by ADEQ and ASARCO, and are in accordance with EPA guidance.

The NAAQS for SO2 are 80 micrograms per cubic meter (μg/m³), 365 μg/m³, and 1,300 μg/m³ on an annual, 24-hour and three-hour average basis, respectively. There have been no violations of Ambient Air Quality Standards for SO2 in the Hayden area since 1995. In June 2002, the State requested EPA to redesignate the Hayden area from non-attainment area to attainment area for SO2.
Particulate Matter Monitoring Data

ASARCO has provided information on regulated sources of particulate matter (PM) emission to ADEQ in the air pollution permit application. ASARCO has submitted separate Title V Permit applications for the Hayden concentrator and Hayden smelter. The PM emission sources at the Hayden concentrator consist of track hopper, conveyor belts, secondary crushing circuit, tertiary crushing circuit, fine ore bins, lime silo, and tailings impoundments AB/BC and D. PM emission sources at the Hayden smelter consist of fluid bed dryers, flash furnace, revert crushing system, converters, anode furnaces, and acid plant. Emissions are exhausted through the 1,000 foot stack, exhaust stacks of individual PM emission control devices for ore handling, as well as fugitives from smelter operation, tailing piles and ore handling.

In addition to ASARCO smelter and concentrator operations, there are other sources of PM emissions in the Hayden and Winkelman area. The PM10 Nonattainment Area Plan (PM10 State Implementation Plan for the Hayden Group I Area [ADEQ, 1989]), prepared by ADEQ and submitted to EPA in 1992, lists automobile exhausts, roadway dust, wood burning stoves, locomotive exhaust and windblown dust as other sources of PM emissions. Relative contribution of each of these sources of PM emissions was estimated in the PM10 Nonattainment Area Plan. However, no analysis of relative contribution of emission sources has been prepared after the required PM10 controls were implemented in the Hayden area.

ADEQ has operated a PM10 sampler at the Hayden Jail monitoring site since February 1985, and has operated a Total Suspended Particulate (TSP) monitor at the same location for preceding years. This is the only station in the study area where PM10 measurements are collected. The NAAQS for PM10 are 50 \( \mu g/m^3 \) and 150 \( \mu g/m^3 \) on an annual arithmetic mean and 24-hour average basis, respectively.

The PM10 Nonattainment Area Plan includes analysis of PM10 samples for elemental composition. Elemental composition of the major source profiles and apportionment calculation results indicated high correlation between emissions from some specific air pollution sources and PM10 collected on sample filter. These sources of air pollution included fugitive area dust sources, ore handling and processing, fugitive emissions from the smelting process, smelter dust and windblown dust from the smelting process. The recommended controls in the PM10 State Implementation Plan have been implemented in the Hayden area. There have been no exceedances of PM10 air quality standards after implementation of the proposed controls.

The ESI (ADEQ, 2003) indicates that data from the monitoring station also indicates that the 24-hour AAAQG for arsenic was exceeded every year from 1991 to 2000, and the annual AAAQG for arsenic has been exceeded every year from 1991 to 2000.

The AAAQGs established for arsenic are 0.28 \( \mu g/m^3 \), 0.0073 \( \mu g/m^3 \), and 0.00002 \( \mu g/m^3 \) for one hour, 24-hour, and annual average exposures, respectively. Arsenic samples were collected by ADEQ using 24-hour PM sampling equipment and filters were analyzed for arsenic content. The concentration of arsenic in samples collected by ADEQ at the Hayden Jail site are significantly higher than established 24-hour and annual AAAQGs.

Limited information is available regarding distribution of chemicals in coarse and fine fraction from each of the emission sources.
Emission Sources in Hayden Area

The initial Hayden smelter was constructed in 1911 and began operations to process ore from the Ray Mine in 1912. A 250 foot stack was built in 1918 to discharge gases from the copper smelter. In 1920, a Cottrel (form of electrostatic precipitator) was installed. In 1961, the Cottrel was converted to wire and plate configuration improving particulate removal efficiency to 99.7 percent. In 1965, furnace gases were also routed to the Cottrel. In 1970, construction began on the acid plant and electrostatic precipitator to treat gases from the converters. The acid plant began operating in 1971.

In 1974, the 1,000 foot stack was built to discharge exhaust gases from the smelting operations. ASARCO also started operating SCSs in 1974. In 1980, secondary hoods were installed on the converters to control fugitive emissions.

The Kennecott smelter was shut down in 1982, and the structures surrounding the stack are currently undergoing demolition by ASARCO.

ASARCO completed modernization of its Hayden smelter in 1983, including installation of an oxygen flash smelting furnace, construction of an oxygen plant to produce oxygen for the new furnace, and construction of a second sulfuric acid plant to capture and re-use SO₂ emissions produced during smelting.
Section 3  Maps

The following is a list of maps and figures pertinent to this FSP and included in this section.

- Figure 3-1
  - Vicinity Map
- Figure 3-2
  - Approximate Limit: Area of Concern
- Figure 3-3
  - Groundwater Sample Point Locations Map
- Figure 3-4
  - Surface Water and Sediment Sample Point Locations Map
- Figure 3-5
  - Surface Soil Sample Point Locations Map
- Figure 3-6
  - Air Sample Monitors Locations Map
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Figure 3-1
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Figure 3-6
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Section 4  Rationale for Sample Locations, Number of Samples, and Laboratory Analyses

4.1  Groundwater Investigation

The sampling rationale for the groundwater investigation (Task 3d) is described in terms of the Site problems detailed in the companion QAPP (DQO step 7) and described in Section 2.5.2.

Data gaps that need to be filled in order to better characterize groundwater quality in the vicinity of the Site include background information on groundwater quality, water quality of alluvial groundwater associated with site drainages, water quality of the uppermost zone of alluvial groundwater in the vicinity of the Hayden wellfield, and groundwater to surface water interactions downstream of the tailings impoundments. To fill these data gaps, seven monitor wells will be installed and two rounds of sampling involving all new and selected existing wells and selected tap samples will be performed. The sampling events will be performed during the time of year with maximum potential for flow in the site alluvium (February-March and July-August).

The RI Workplan and QAPP call for a judgmental sampling design. Sample locations are predetermined by the location of the wells, and not on the basis of statistical selection. The new wells have been located based on potential source areas, interpretation of distribution of contamination, predicted groundwater flow directions, geographic constraints, property ownership constraints, and equipment access constraints.

The sample locations are shown on Figure 3-3. The proposed sample analyses are shown in Table 5.2-1.

4.2  Surface Water and Sediment Investigation

The sampling rationale for the surface water and sediment investigation (Task 3c) is described in terms of the Site problems detailed in the companion QAPP (DQO step 7) and described in Section 2.5.3.

The data gaps that need to be filled include the impacts to ecological receptors from Site operations, impacts to sediments in the drainage washes near Site operations, and better definition of background soil quality. To fill these data gaps, surface water samples will be collected from the Gila River, San Pedro River, Tailings Ponds AB/BC, and Tailings Pond D. Sediment samples will be collected from in-channel and floodplain areas of the Gila River and San Pedro River, and from the tailings ponds, main drainage washes, other areas near Site operations, and upland areas.
The sampling design is judgmental. The sample locations have been selected based on potential source areas, interpretation of distribution of contamination, geographic constraints, property ownership constraints, and personnel access constraints. The locations are shown on Figure 3-4. The proposed sample analyses are shown in Tables 5.2-2 and 5.2-3.

4.3 Surface Soils Investigation

The sampling rationale for the surface soils investigation (Task 3b) is described in terms of the Site problems detailed in the companion QAPP and described in Section 2.5.3.

Data collected from the proposed surficial soil sampling sites will enable evaluation of whether contaminants at concentrations greater than specified levels are present over specific areas and will allow evaluation of sources areas.

The sampling design is defined based on the professional judgment regarding the need to fill data gaps on the potential exposure to human receptors and the potential extent of contamination from process operations. To assess potential impact to human receptors, samples will be collected from the yard of each habitable home in the towns of Hayden and Winkelman, and from selected school and park areas. Since the area that is likely impacted by process operations is fairly broad, and in order to develop an understanding of the specific nature and distribution of contamination in surficial soils, it is deemed necessary to sample according to a uniform spatial grid over broad areas to further define specific areas of contamination. Given the relatively large area addressed by sampling, it is also necessary to utilize cost-effective data collection methods such as x-ray fluorescence (XRF) for analyzing the soil samples.

The XRF analyses are generally considered to be less precise than laboratory analyses, and these analyses must therefore be complemented by laboratory analyses to adequately correlate results. The frequency of laboratory analyses relative to XRF analyses of surficial soil samples proposed in the RI Workplan (1 in 10) is a generally accepted ratio. Depending upon how successfully the results of the two types of analyses correlate during the early phase of the investigation, the data collection methods specified in the RI Workplan may be subject to revision. Alternatives to the frequency proposed in the RI Workplan for both XRF and laboratory analyses may include increasing the frequency of samples submitted for laboratory analysis, or complete substitution of XRF analyses for laboratory analyses. This decision will be based on professional judgment and a statistical analysis of the correlation of XRF data to laboratory analyses from a test area during the early phase of the field investigation.

The following summarizes the sampling strategy to be used in the dry wash sampling to be conducted at the ASARCO Hayden facility. Sampling objectives are to both characterize metal concentrations in two dry washes and establish the calibration of field XRF to laboratory quantitation of metals of interest, particularly in the range of risk-based decision making concentrations. The following bullets summarize the sampling design, including
SECTION 4 RATIONALE FOR SAMPLE LOCATIONS, NUMBER OF SAMPLES, AND LABORATORY ANALYSES

collocated and duplicate sample allocations; describe data evaluation objectives and procedures; and provide a prototype for the structure of the database of sample results.

**Sampling Strategy**

- Two dry washes, to be sampled, are known as San Pedro Wash and Power House Canyon Wash and are shown in Figure 4-1 from the RI Workplan. Wash selection was based upon proximity and distance from the facility. The objective is to compare metal concentrations in soils near (~500 - 1000 feet) and far (~2,000 feet) from the ASARCO facility which is a source of aerial deposition and fugitive dusts. Wind patterns are variable in the area so primary consideration in selection was distance from the site. The washes are dry most of the year but collect surface water runoff during storm events.

- Grid spacing will be approximately 300 feet, resulting in approximately 15 nodes per wash. Assuming no measurement error, square grid spacing of 300 feet is sufficient to assure that no localized anomalies greater than 177 foot radius will go undetected with 95 percent confidence. A sample size of 15 gives reasonable distributional coverage and is sufficient to characterize the upper 80th percentile of a population with 95 percent confidence.

- Field duplicate, split samples will be collected in 10 percent of locations sampled, resulting in 2 duplicates per wash. Duplicates will be collected at both the primary and collocated nodes, as indicated above. The field duplicates will estimate variability associated with small- and larger-scale spatial differences in one area of each of the two washes.

- All sample locations will include surface soil collection for analysis. In the event anomalously high XRF field results are found, subsurface soils from the same location will be sampled in order to estimate how the depth to which anomalous levels extend.

- All characterization and QA/QC samples will be quantified for the Target Analyte List (TAL) metals of interest using both field XRF and off-site laboratory wet chemistry.

**Data Evaluation**

- XRF-Laboratory Calibration  A linear regression will be established for each metal of interest, calibrating XRF values to laboratory results. The relationship will be used to calculate a 95 percent confidence interval on the laboratory - XRF calibration curve around critical values of concern for the metals.

- Wash-specific sample results from field duplicate and collocate paired results will be used to calculate variances associated with split and small-scale spatial differences. These estimates will be compared to wash-wide variability and displayed graphically.

- Metal-specific differences between washes will be compared both explicitly (using either a T-test or nonparametric Mann-Whitney test) and through graphical displays,
including boxplots. BOXPLOT.doc is a generic prototype of the displays which identifies components in the display and interpretation.

The individual sample locations are shown on Figure 3-5. Proposed associated analyses are also shown in Tables 5.2-4A and 5.2-4B.

### 4.4 Air and Indoor Dust Investigation

The sampling rationale for the air and indoor dust investigation (Task 3e) is described in terms of the Site problems detailed in the companion QAPP (DQO step 7) and described in Section 2.5.5.

For ambient air monitoring, the stations have been determined to fill data gaps related to the nature of air contaminants, the potential impact to human receptors, and parameters needed for an air dispersion model. To fill these data gaps, air monitoring stations will be established within the residential area of the town of Hayden, and at the public school complex in Winkelman. The stations will be used to collect metals data for collected particulates and meteorological data. The air monitoring stations are shown on Figure 3-6. Associated analytes are also shown in Table 5.2.

For indoor dust sampling, data are needed to assess potential impacts to human receptors in the towns of Hayden and Winkelman. This assessment, however, will be preliminary in nature. Therefore, a total of 10 houses in Hayden and 10 houses in Winkelman have been selected for indoor and attic dust sampling. These locations will be selected in the field, such that approximately 6 locations are closest to Site operations, and the remaining 4 locations are in more distant areas of town, to provide relatively broad data distribution. Associated analytes are shown in Table 5.2.

For ambient air monitoring, the stations have been determined to fill data gaps related to the nature of air contaminants and the potential impact to human receptors. To fill these data gaps, air monitoring stations will be established within the residential area of the town of Hayden, and at the public school complex in Winkelman. The stations will be used to collect metals data for collected particulates and meteorological data. The air monitoring stations are shown on FSP Figure 3-6. Associated analytes are also shown in FSP Table 5.2.

For indoor dust sampling, data are needed to assess potential impacts to human receptors in the towns of Hayden and Winkelman. This assessment, however, will be preliminary in nature. Therefore, a total of 10 houses in Hayden and 10 houses in Winkelman have been selected for indoor and attic dust sampling. These locations will be selected in the field, such that approximately 6 locations are closest to Site operations, and the remaining 4 locations are in more distant areas of town, to provide relatively broad data distribution. Associated analytes are shown in FSP Table 5.2-5.
4.5 Investigation Derived Waste (IDW) – Drill Cuttings

The rationale for IDW sampling is described in terms of the Site problems detailed in the companion QAPP.

The IDW will be generated primarily during the installation and sampling of new monitor wells under Task 3d (Groundwater Investigation). IDW generated during well installation will consist of drill cuttings and water.

The option of leaving the drill cuttings and water on-Site is being evaluated. This option will be followed if it meets with approval from the regulatory agencies and property owners; analysis of samples may not be required if this option is selected. If investigation derived drill cuttings cannot be left on-Site, the following sampling and analyses are being considered.

The materials are expected to be fairly homogeneous and concentrations are expected to below regulatory levels specified on the target compound list (TCL). Therefore, one drill water and one drill cuttings sample per well location will be collected. The drill water sample will be collected using a new, disposable polyethylene bailer to fill the appropriate sample containers. Drill cuttings composite samples will be collected and placed directly into a laboratory-provided 8-ounce glass jar, allowing as little headspace as possible. The sample analyses will be limited to the toxic characteristics leaching procedure (TCLP) analysis for Site specific compound groups of concern (TCLP volatile organic compounds (VOC), semi-volatile organic compounds (SVOC) and metals) rather than the full TCLP list, as well as reactivity, corrosivity, ignitability (RCI) and paint filter. The landfill may require additional analyses to meet acceptance criteria; however, these additional analytes are currently unknown since the landfill has not been selected. Proposed associated sample analyses are shown in Table 5.2-7.

4.6 Investigation Derived Waste (IDW) – Purge Water

The rationale for IDW sampling is described in terms of the Site problems detailed in the companion QAPP.

The IDW will be generated primarily during the sampling of new monitor wells under Task 3d (Groundwater Investigation), and will consist of purge water.

The option of leaving purge water on-Site is being evaluated. This option will be followed if it meets with approval from the regulatory agencies and property owners; analysis of samples may not be required if this option is selected. If investigation derived purge water cannot be left on-Site, then the following sampling and analyses is being considered.

The well development water from different depths will be mixed and then stored in individual containers (20,000 gallon Baker™ tank or alternative tank if appropriate). One sample from each tank will be collected. Well development water samples will be collected using a new, disposable polyethylene bailer to fill the appropriate sample containers,
allowing no headspace where necessary. The samples will be analyzed for Site specific compound groups of interest, including VOCs, SVOCs and metals. Additional analyses may be required, depending on the selected method of disposal.

Proposed associated sample analyses are shown in Table 5.2-8.
Section 5  Request for Analyses

5.1 Analytical Parameters

This section presents the requests for analyses of groundwater samples that will be collected. Table 5.1 summarizes the analytical parameters, test methods, and target detection limits. Laboratory analyses will be performed by CLP, EPA's Region IX laboratory, and contract laboratories as shown in Table 5.2.

Table 5.1
Analyte and Methods List
ASARCO LLC Hayden Plant Smelter

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<th>Parameter</th>
<th>Method</th>
<th>Reporting Limit/Target Detection Limit</th>
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<td><strong>TAL Inorganics</strong></td>
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<td>(plus boron and molybdenum)</td>
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<td><strong>TCL VOCs</strong></td>
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### Table 5.1
Analyte and Methods List
**ASARCO LLC Hayden Plant Smelter**

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<th>Parameter</th>
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<td>Xylenes (total)</td>
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**TCL SVOCs:**
*(plus carbazole)*

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### Table 5.1
**Analyte and Methods List**

**ASARCO LLC Hayden Plant Smelter**

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<th>Parameter</th>
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<th>Reporting Limit/Target Detection Limit</th>
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<td>bis(2-Chloroisopropyl)ether</td>
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<tr>
<td>Pyrene</td>
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</table>

**Radiochemicals:**

| Gross alpha                             | EPA 900.0 | 3 pCi/L |

---

5-3
### Table 5.1

*Analyte and Methods List*

**ASARCO LLC Hayden Plant Smelter**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Method</th>
<th>Reporting Limit/Target Detection Limit</th>
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<tr>
<td>Gross beta</td>
<td>EPA 900.0</td>
<td>4 pCi/L</td>
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<td>Uranium (total)</td>
<td>EPA 6020 or CLP</td>
<td>0.01 ug/L</td>
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<tr>
<td>Thorium (total)</td>
<td>EPA 6020 or CLP</td>
<td>0.02 ug/L</td>
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<td>Radium 226</td>
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<tr>
<td>Radium 228</td>
<td>EPA 904.1</td>
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**Total Petroleum Hydrocarbons:**

- Diesel Range Organics (DRO): EPA 8015 1 mg/L
- Gasoline Range Organics (GRO): EPA 8015 0.1 mg/L
- Oil Range Organics (ORO): EPA 8015 1 mg/L

**General Parameters:**

- Total Dissolved Solids (TDS): EPA 160.1 20 mg/L
- Chloride: EPA 300 1.0 mg/L
- Sulfate: EPA 300 1 mg/L
- Fluoride: EPA 300 0.1 mg/L
- Carbonate/Bicarbonate: SM2320 20 mg/L

**Field Parameters:**

- Dissolved oxygen: Field
- Specific conductance: Field
- Temperature: Field
- pH: Field

**Surface Water Analyses**

*(plus boron and molybdenum)*

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<th>(ug/L)</th>
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<td>Boron</td>
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<td>Cobalt</td>
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<tr>
<td>Sodium</td>
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### Table 5.1
Analyte and Methods List
*ASARCO LLC Hayden Plant Smelter*

<table>
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<tr>
<th>Parameter</th>
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<th>Reporting Limit/Target Detection Limit</th>
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<td>Thallium</td>
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<td>Zinc</td>
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**General Parameters:**

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<th>Parameter</th>
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<td>Total Dissolved Solids (TDS)</td>
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**Field Parameters:**

- **pH** Field: --
- **Dissolved Oxygen** Field: --
- **Specific Conductance** Field: --
- **Temperature** Field: --
- **Turbidity** Field: --
- **Salinity** Field: --

**Sediment Analyses**

**TAL Inorganics:** *(plus boron and molybdenum)*

<table>
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<tr>
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<td>Beryllium</td>
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<td>Boron</td>
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<td>Cadmium</td>
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<tr>
<td>Cobalt</td>
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<tr>
<td>Cyanide</td>
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Table 5.1
Analyte and Methods List
ASARCO LLC Hayden Plant Smelter

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Method</th>
<th>Reporting Limit/Target Detection Limit</th>
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<td>Percent Solids</td>
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<td>60 Seconds/120Seconds runtime</td>
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<tr>
<td>Aluminum</td>
<td>XRF</td>
<td>--</td>
</tr>
<tr>
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<td>XRF</td>
<td>250/175</td>
</tr>
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<tr>
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<td>XRF</td>
<td>--</td>
</tr>
<tr>
<td>Beryllium</td>
<td>XRF</td>
<td>--</td>
</tr>
<tr>
<td>Boron</td>
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<td>--</td>
</tr>
<tr>
<td>Cadmium</td>
<td>XRF</td>
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<td>XRF</td>
<td>200/150</td>
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<tr>
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<td>XRF</td>
<td>--</td>
</tr>
<tr>
<td>Manganese</td>
<td>XRF</td>
<td>250/175</td>
</tr>
<tr>
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</tr>
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<td>XRF</td>
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<tr>
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<td>XRF</td>
<td>--</td>
</tr>
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<td>Vanadium</td>
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</tr>
<tr>
<td><strong>(plus boron and molybdenum)</strong></td>
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<td>20</td>
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<tr>
<td>Boron</td>
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<td>(a)</td>
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<tr>
<td>Cadmium</td>
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<tr>
<td>Chromium</td>
<td>CLP</td>
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<td>Cobalt</td>
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<tr>
<td>Copper</td>
<td>CLP</td>
<td>2.5</td>
</tr>
<tr>
<td>Iron</td>
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<td>10</td>
</tr>
<tr>
<td>Lead</td>
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<td>Manganese</td>
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<td>1.5</td>
</tr>
<tr>
<td>Mercury</td>
<td>CLP</td>
<td>0.1</td>
</tr>
<tr>
<td>Molybdenum</td>
<td>CLP</td>
<td>(a)</td>
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### Table 5.1
Analyte and Methods List
**ASARCO LLC Hayden Plant Smelter**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Method</th>
<th>Reporting Limit/Target</th>
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<td></td>
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<td>Thallium</td>
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<td>2.5</td>
</tr>
<tr>
<td>Uranium</td>
<td>CLP</td>
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<tr>
<td>Vanadium</td>
<td>CLP</td>
<td>5</td>
</tr>
<tr>
<td>Zinc</td>
<td>CLP</td>
<td>6</td>
</tr>
<tr>
<td>Cyanide</td>
<td>CLP</td>
<td>2.5</td>
</tr>
<tr>
<td>Nickel</td>
<td>CLP</td>
<td>4</td>
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<tr>
<td>Selenium</td>
<td>CLP</td>
<td>3.5</td>
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<tr>
<td>Silver</td>
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<td>1</td>
</tr>
<tr>
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<td>CLP</td>
<td>2.5</td>
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<tr>
<td>Uranium</td>
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<td>Vanadium</td>
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<tr>
<td>Zinc</td>
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</tr>
<tr>
<td>Cyanide</td>
<td>CLP</td>
<td>2.5</td>
</tr>
</tbody>
</table>

**General Parameters:**
- Total Organic Carbon: ASTM C D 4839
- pH: EPA 9045
- Percent Solids: EPA 160 Mod

**Geotechnical Parameters:**
- Cation Exchange Capacity: ASTM 9081
- Grain Size: ASTM C 136

**TAL Metals:**
*(plus boron and molybdenum)*
- Aluminum: XRF
- Antimony: XRF 250/175
- Arsenic: XRF 20/15
- Barium: XRF
- Beryllium: XRF
- Boron: XRF
- Cadmium: XRF
- Chromium: XRF 60/45
- Cobalt: XRF 200/150
- Copper: XRF 10/60
- Iron: XRF 250/175
- Lead: XRF 25/20
- Magnesium: XRF
- Manganese: XRF 250/175
- Mercury: XRF 20/12
- Molybdenum: XRF
- Nickel: XRF 120/90
- Selenium: XRF 20/15
- Silver: XRF 70/50
- Thallium: XRF
- Uranium: XRF
- Vanadium: XRF 250/175
- Zinc: XRF 55/40

**Indoor Residential & Attic Dust Sampling**

**TAL Inorganics:** *(plus boron and molybdenum)*
- Aluminum: CLP 20
- Antimony: CLP 6
### Table 5.1

**Analyte and Methods List**

**ASARCO LLC Hayden Plant Smelter**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Method</th>
<th>Reporting Limit/Target Detection Limit</th>
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<tbody>
<tr>
<td>Arsenic</td>
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<tr>
<td>Boron</td>
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<td>(a)</td>
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<tr>
<td>Cadmium</td>
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<td>Chromium</td>
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<tr>
<td>Cobalt</td>
<td>CLP</td>
<td>5</td>
</tr>
<tr>
<td>Copper</td>
<td>CLP</td>
<td>2.5</td>
</tr>
<tr>
<td>Iron</td>
<td>CLP</td>
<td>10</td>
</tr>
<tr>
<td>Lead</td>
<td>CLP</td>
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</tr>
<tr>
<td>Magnesium</td>
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<tr>
<td>Manganese</td>
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</tr>
<tr>
<td>Mercury</td>
<td>CLP</td>
<td>0.1</td>
</tr>
<tr>
<td>Molybdenum</td>
<td>CLP</td>
<td>(a)</td>
</tr>
<tr>
<td>Nickel</td>
<td>CLP</td>
<td>4</td>
</tr>
<tr>
<td>Selenium</td>
<td>CLP</td>
<td>3.5</td>
</tr>
<tr>
<td>Silver</td>
<td>CLP</td>
<td>1</td>
</tr>
<tr>
<td>Thallium</td>
<td>CLP</td>
<td>2.5</td>
</tr>
<tr>
<td>Uranium</td>
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<tr>
<td>Chromium VI</td>
<td>EPA 7196</td>
<td>(a)</td>
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</table>

**Ambient Air Monitoring**

Metals: EPA IO-3 (b)

- Antimony
- Arsenic
- Barium
- Cadmium
- Chromium
- Cobalt
- Copper
- Lead*
- Manganese
- Mercury
- Nickel
- Selenium
- Silver
- Vanadium
- Zinc

**Investigation Derived Soil Waste**

TCLP VOC: EPA 1311/CLP

- Benzene
- carbon tetrachloride
- Chlorobenzene
- Chloroform
### Table 5.1
**Analyte and Methods List**
**ASARCO LLC Hayden Plant Smelter**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Method</th>
<th>Reporting Limit/Target Detection Limit</th>
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</thead>
<tbody>
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<td>1,2-dichloroethane</td>
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<tr>
<td>1,1-dichloroethylene</td>
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<tr>
<td>Methyl ethyl ketone</td>
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<td>Tetrachlorethylene</td>
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<tr>
<td>Trichloretylene</td>
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<tr>
<td>Vinyl chloride</td>
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<td><strong>TCLP SVOC:</strong></td>
<td>EPA 1311/CLP</td>
<td>CLP (c)</td>
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<tr>
<td>m-cresol</td>
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<td></td>
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<tr>
<td>o-cresol</td>
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<tr>
<td>p-cresol</td>
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</tr>
<tr>
<td>1,4-dichlorobenzene</td>
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<td></td>
</tr>
<tr>
<td>2,4-dinitrotoluene</td>
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<td>Hexachlorobutadiene</td>
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<td>Hexachlorobenzene</td>
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<tr>
<td>Hexachlorethane</td>
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<tr>
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<td>Pyridine</td>
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<td>2,4,5-trichlorophenol</td>
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<td>2,4,6-trichlorophenol</td>
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<td><strong>TCLP Metals:</strong></td>
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<tr>
<td>Chromium</td>
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<td></td>
</tr>
<tr>
<td>Lead</td>
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<td></td>
</tr>
<tr>
<td>Mercury</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Selenium</td>
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<tr>
<td>Silver</td>
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<td>Reactivity</td>
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<td>Corrosivity</td>
<td>EPA 1110</td>
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<td>Ignitability</td>
<td>EPA 1030</td>
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<tr>
<td>Paint-filter Test</td>
<td>EPA 9095</td>
<td>NA</td>
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</tbody>
</table>

#### Investigation Derived Water Waste (ug/L)

| TCL Volatiles: | CLP | CLP (c) |
| TCL Semivolatiles: | CLP | CLP |
| TAL Inorganics: | CLP | CLP |

**Notes:**

- **ASTM** American Society for Testing and Materials
- **CLP** contract laboratory program
- **EPA** Environmental Protection Agency
- **HNO₃** nitric acid
- **H₂SO₄** sulfuric acid
- **HCl** hydrochloric acid
- **mg/kg** milligrams per kilogram
- **mg/L** milligrams per liter
- **NA** Not Applicable
Table 5.1
Analyte and Methods List
ASARCO LLC Hayden Plant Smelter

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Method</th>
<th>Reporting Limit/Target Detection Limit</th>
</tr>
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<tbody>
<tr>
<td>pCi/L</td>
<td>picocuries per liter</td>
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<tr>
<td>pH</td>
<td>potential of hydrogen</td>
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<td>SVOC</td>
<td>semi volatile organic compound</td>
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<td>TAL</td>
<td>target analyte list</td>
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<td>toxicity characteristic leaching procedure</td>
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<td>ug/L</td>
<td>micrograms per liter</td>
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<tr>
<td>VOC</td>
<td>volatile organic compound</td>
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<tr>
<td>XRF</td>
<td>x-Ray fluorescence (note that “—” indicates that detection limit not defined for these metals.)</td>
<td></td>
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</tbody>
</table>

(a) Limits will be laboratory specific and will be identified prior to start of analyses.
(b) Sample preparation method with filter and cartridge will be laboratory specific and will be described in a standard operating procedure prior to analyses. (EPA Compendium of Methods for the Determination of Inorganic Compounds in Ambient Air, Center for Environmental Research Information, Office of Research and Development, U.S. Environmental Protection Agency, Cincinnati, OH 45268, June 1999).
(c) Same as the groundwater limits shown above; they are below the regulatory TCLP limits.

5.2 Request for Analyses

Request for analyses is presented in Tables 5.2-1 through 5.2-8 below as follows:

- Groundwater 5.2-1
- Surface Water 5.2-2
- Sediments 5.2-3
- Surficial Soil 5.2-4
- Indoor Residential and Attic Analyses 5.2-5
- Air Monitoring 5.2-6
- Investigation Derived Soil Waste 5.2-7
- Investigation Derived Water Waste 5.2-8
### Table 5.2-1: Request for Analyses - Groundwater Analyses

#### ASARCO LLC Hayden Plant Smelter

<table>
<thead>
<tr>
<th>Anticipated Laboratory Performing Analysis</th>
<th>CLP</th>
<th>CLP</th>
<th>CLP</th>
<th>Contract</th>
<th>Contract</th>
<th>Contract</th>
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<th>EPA Regional Lab</th>
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<th>EPA Regional Lab</th>
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<td><strong>Method</strong></td>
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<td>CLP</td>
<td>CLP</td>
<td>EPA 900.0</td>
<td>EPA 6020 or CLP</td>
<td>EPA 903.1</td>
<td>EPA 904.1</td>
<td>EPA 8015</td>
<td>EPA 8015</td>
<td>EPA 8015</td>
<td>EPA 160.1</td>
<td>EPA 300</td>
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<tr>
<td><strong>Specific Analyses Requested</strong></td>
<td>TAL: Inorganics</td>
<td>TCL VOCs</td>
<td>TCL SVOCs</td>
<td>Gross alpha</td>
<td>Gross beta</td>
<td>Uranium (total)</td>
<td>Thorium (total)</td>
<td>Radium 226</td>
<td>Radium 228</td>
<td>TPH - ORO</td>
<td>TPH - ORO</td>
<td>Total Dissolved Solids (TDS)</td>
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<td><strong>Preservatives</strong></td>
<td>HNO₃ to pH &lt;2; Chill to 4°C</td>
<td>Chill to 4°C</td>
<td>HNO₃ to pH &lt;2; Chill to 4°C</td>
<td>HNO₃ to pH &lt;2; Chill to 4°C</td>
<td>HNO₃ to pH &lt;2; Chill to 4°C</td>
<td>Chill to 4°C</td>
<td>HCl to pH &lt;2; Chill to 4°C; No Headspace</td>
<td>Chill to 4°C</td>
<td>Chill to 4°C</td>
<td>Chill to 4°C</td>
<td>Chill to 4°C</td>
<td>Chill to 4°C</td>
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<td><strong>Analytical Holding Time</strong></td>
<td>&lt;28 days for Hg; 6 months for others</td>
<td>Hold &lt;14 days</td>
<td>&lt;28 days for Hg; 6 months for others</td>
<td>&lt;28 days for Hg; 6 months for others</td>
<td>&lt;28 days for Hg; 6 months for others</td>
<td>&lt;28 days for Hg; 6 months for others</td>
<td>&lt;7 days until extraction and 40 days after extraction</td>
<td>&lt;14 days; 7 days if unreserved prior to extraction</td>
<td>&lt;7 days until extraction and 40 days after extraction</td>
<td>&lt;7 days</td>
<td>&lt;28 days</td>
<td>&lt;14 days</td>
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</table>

#### Contract Holding Time

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<th>Conc.</th>
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<th>3x40 mL glass vial</th>
<th>1x-1 L, amber bottle</th>
<th>1x-1 L, poly bottle</th>
<th>1x-1 L, poly bottle</th>
<th>1x-1 L, amber bottle</th>
<th>1x-1 L, poly bottle</th>
<th>1x-1 L, amber bottle</th>
<th>1x-1 L, poly bottle</th>
<th>1x-1-100 mL, poly bottle</th>
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<tbody>
<tr>
<td><strong>New Monitor Wells</strong></td>
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</table>
## Table 5.2-1 (Continued)

**Request for Analyses - Groundwater Analyses**

| ARU-6  | ARU-6-mmddyy | Winter/Summer | Low | 1 | 1 | 1 | 1 | 1 | 1 |
| ARU-10 | ARU-10-mmddyy| Winter/Summer | Low | 1 | 1 | 1 | 1 | 1 | 1 |
| ARU-12 | ARU-12-mmddyy| Winter/Summer | Low | 1 | 1 | 1 | 1 | 1 | 1 |
| S-4A(San Pedro) | S-4A-mmddyy | Winter/Summer | Low | 1 | 1 | 1 | 1 | 1 | 1 |
| MW-2  | MW-2-mmddyy  | Winter/Summer | Low | 1 | 1 | 1 | 1 | 1 | 1 |
| MW-4  | MW-4-mmddyy  | Winter/Summer | Low | 1 | 1 | 1 | 1 | 1 | 1 |

### Existing Water Supply Wells

| HWF-15 | HWF-15-mmddyy | Winter/Summer | Low | 1 | 1 | 1 | 1 | 1 | 1 |
| HWF-21 | HWF-21-mmddyy | Winter/Summer | Low | 1 | 1 | 1 | 1 | 1 | 1 |
| HWF-25 | HWF-25-mmddyy | Winter/Summer | Low | 1 | 1 | 1 | 1 | 1 | 1 |
| HWF-25 | HWF-25-mmddyy | Winter/Summer | Low | 1 | 1 | 1 | 1 | 1 | 1 |
| HWF-25 | HWF-25-mmddyy | Winter/Summer | Low | 1 | 1 | 1 | 1 | 1 | 1 |
| HWF-25 | HWF-25-mmddyy | Winter/Summer | Low | 1 | 1 | 1 | 1 | 1 | 1 |
| Winkelman No. 3 | WM-3-mmddyy | Winter/Summer | Low | 1 | 1 | 1 | 1 | 1 | 1 |
| Winkelman No. 4 | WM-4-mmddyy | Winter/Summer | Low | 1 | 1 | 1 | 1 | 1 | 1 |

### Hand Samples

| HWFM | HWFM-mmddyy | Winter/Summer | Low | 1 | 1 | 1 | 1 | 1 | 1 |
| WWFM | WWFM-mmddyy | Winter/Summer | Low | 1 | 1 | 1 | 1 | 1 | 1 |

### Drinking Water Samples

| Winkelman School Complex (Elementary School) | WSch-mmddyy | Winter/Summer | Low | 1 | 1 | 1 | 1 | 1 | 1 |
| Hayden Library | HL-mmddyy | Winter/Summer | Low | 1 | 1 | 1 | 1 | 1 | 1 |
| Hayden Park | HP-mmddyy | Winter/Summer | Low | 1 | 1 | 1 | 1 | 1 | 1 |

### Total Well Samples

| 37 | 37 | 37 | 37 | 37 | 37 | 37 | 37 | 37 | 37 | 37 | 37 | 37 | 37 |

### Total Duplicates

| 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

### Total Equipment Blanks

| ~49 | ~49 | ~49 | ~49 | ~49 | ~49 | ~49 | ~49 | ~49 | ~49 | ~49 | ~49 | ~49 | ~49 |

### Total Laboratory QC (MS/MSD) Samples

| ~49 | ~49 | ~49 | ~49 | ~49 | ~49 | ~49 | ~49 | ~49 | ~49 | ~49 | ~49 | ~49 | ~49 |

### Notes:
- CLP: contract laboratory program
- DRO: diesel range organics
- DUP: duplicate sample
- EPA: Environmental Protection Agency
- GRO: gasoline range organics
- HCl: hydrochloric acid
- Hg: mercury
- HN03: nitric acid
- L: liter
- Lab QC MS/MSD: matrix spike/matrix spike duplicate (sample set which will be twice the normal sample volume)
- mL: milliliter
- ORO: oil range organics
- pH: potential of hydrogen
- SM: sample method
- SVOC: semi volatile organic compound
- TAL: target analyte list
- TCL: target compound list
- TPH: total petroleum hydrocarbons
- VOC: volatile organic compound
- * mmddyy indicates well or sample designation name should be followed by month, day and year denoting date of sample collection
### Table 5.2-2: Request for Analyses - Surface Water Analyses

**ASARCO LLC Hayden Plant Smelter**

<table>
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<th>Anticipated Laboratory Performing Analysis</th>
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<th>EPA Regional Lab</th>
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<td>EPA 160.1</td>
<td>EPA 160.2</td>
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<td>Specific Analyses Requested</td>
<td>TAL Inorganics</td>
<td>Total Dissolved Solids (TDS)</td>
<td>Total Suspended Solids (TSS)</td>
<td>Alkalinity</td>
<td>Ammonia</td>
<td>Hardness</td>
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<td>Preservatives</td>
<td>HNO₃ to pH&lt;2, Chill to 4° C</td>
<td>Chill to 4° C</td>
<td>Chill to 4° C</td>
<td>Chill to 4° C</td>
<td>HNO₃ to pH&lt;2, Chill to 4° C</td>
<td>HNO₃ to pH&lt;2, Chill to 4° C</td>
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<td>Analytical Holding Time</td>
<td>&lt;28 days for Hg &lt;6 months for others</td>
<td>&lt;7 days</td>
<td>&lt;7 days</td>
<td>&lt;14 days</td>
<td>&lt;28 days</td>
<td>&lt; 6 months</td>
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<td>Contract Holding Time</td>
<td>Bottles/Analysis</td>
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<td>1x1-L poly bottle</td>
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<td>GR2</td>
<td>Upstream of Main Study Area</td>
<td>GR-SW-02-mmtd by</td>
<td>TBD</td>
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<td>100 ml. poly bottle</td>
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<td>Downstream of Slag Pile</td>
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<td>~5 (1/day)</td>
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**Notes:**

- C = Celsius
- CLP = contract laboratory program
- DUP = duplicate sample ("DUP" will be labeled so that it is blind to laboratory)
- EPA = Environmental Protection Agency
- HCl = hydrochloric acid
- Hg = mercury
- HNO₃ = nitric acid
- H₂SO₄ = sulfuric acid
- L = liter
- mL = milliliter
- MS/MSD = matrix spike/matrix spike duplicate (sample set which will be twice the normal sample volume)
- pH = potential of hydrogen
- SM = sample method
- TAL = target analyte list
- TBD = to be determined (early spring 2006 is likely)
### TABLE 5.2-3
Request for Analyses - **Sediment Analysis**
ASARCO LLC Hayden Plant Smelter

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<td>TAL Metals</td>
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### TABLE 5.2-3
Request for Analyses - Sediment Analysis
ASARCO LLC Hayden Plant Smelter

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### Request for Analyses - Sediment Analysis

**ASARCO LLC Hayden Plant Smelter**

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**Additional Stable Riparian Areas**

**San Pedro River**

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### TABLE 5.2-3
Request for Analyses - Sediment Analysis
ASARCO LLC Hayden Plant Smelter

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<td>1</td>
</tr>
<tr>
<td>SW-central portion of Tailings Pond A</td>
<td>GRFP-</td>
<td>TBD</td>
<td>Low</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>West of Tailings Pond A</td>
<td>GRFP-</td>
<td>TBD</td>
<td>Low</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>Upland Areas</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UP-1 – NW of Tailings Pile AB-BC – surface (0-2&quot;)</td>
<td>UP-SS-O1-0-mmddyy</td>
<td>TBD</td>
<td>Low</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>
### TABLE 5.2-3
Request for Analyses - **Sediment Analysis**
ASARCO LLC Hayden Plant Smelter

<table>
<thead>
<tr>
<th>Location Description</th>
<th>Sample Code</th>
<th>TBD</th>
<th>Code 1</th>
<th>Code 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>NW of Tailings Pile AB-BC - subsurface (10-12&quot;)</td>
<td>UP-SS-O1-1-mmddyy</td>
<td>TBD</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>NE of Tailings Pile AB-BC - surface (0-2&quot;)</td>
<td>UP-SS-O2-0-mmddyy</td>
<td>TBD</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>NE of Tailings Pile AB-BC – surface (0-2&quot;)</td>
<td>UP-SS-O2-0-mmddyy-DUP</td>
<td>TBD</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>NE of Tailings Pile AB-BC – surface (0-2&quot;)</td>
<td>UP-SS-O2-0-mmddyy-MSD</td>
<td>TBD</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>NE of Tailings Pile AB-BC – surface (0-2&quot;)</td>
<td>UP-SS-O2-1-mmddyy</td>
<td>TBD</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>NE of Tailings Pile AB-BC - subsurface (10-12&quot;)</td>
<td>UP-SS-O2-1-mmddyy</td>
<td>TBD</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>N of Concentrator Facility - surface (0-2&quot;)</td>
<td>UP-SS-O3-0-mmddyy</td>
<td>TBD</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>N of Concentrator Facility - subsurface (10-12&quot;)</td>
<td>UP-SS-O3-1-mmddyy</td>
<td>TBD</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>N side of Gila - Upstream - surface (0-2&quot;)</td>
<td>UP-SS-O4-0-mmddyy</td>
<td>TBD</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>N side of Gila - Upstream - subsurface (10-12&quot;)</td>
<td>UP-SS-O4-1-mmddyy</td>
<td>TBD</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>N side of Gila - Upstream of Slag Pile - surface (0-2&quot;)</td>
<td>UP-SS-O5-0-mmddyy</td>
<td>TBD</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>N side of Gila - Upstream of Slag Pile - subsurface (10-12&quot;)</td>
<td>UP-SS-O5-1-mmddyy</td>
<td>TBD</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Hilltop south of Smelter - surface (0-2&quot;)</td>
<td>UP-SS-O6-0-mmddyy</td>
<td>TBD</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Hilltop south of Smelter – subsurface (10-12&quot;)</td>
<td>UP-SS-O6-1-mmddyy</td>
<td>TBD</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>SW of Winkelman, S side of Gila - surface (0-2&quot;)</td>
<td>UP-SS-O7-0-mmddyy</td>
<td>TBD</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>SW of Winkelman, S side of Gila – surface (0-2&quot;)</td>
<td>UP-SS-O7-0-mmddyy-DUP</td>
<td>TBD</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>SW of Winkelman, S side of Gila - subsurface (10-12&quot;)</td>
<td>UP-SS-O7-1-mmddyy</td>
<td>TBD</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>S of Site near San Pedro - surface (0-2&quot;)</td>
<td>UP-SS-O8-0-mmddyy</td>
<td>TBD</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>S of Site near San Pedro - subsurface (10-12&quot;)</td>
<td>UP-SS-O8-1-mmddyy</td>
<td>TBD</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>East of Tailings Pond D - surface (0-2&quot;)</td>
<td>UP-SS-O9-0-mmddyy</td>
<td>TBD</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>East of Tailings Pond D – subsurface (10-12&quot;)</td>
<td>UP-SS-O9-1-mmddyy</td>
<td>TBD</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>SW of Tailings Pond D - surface (0-2&quot;)</td>
<td>UP-SS-10-0-mmddyy</td>
<td>TBD</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>SW of Tailings Pond D – subsurface (10-12&quot;)</td>
<td>UP-SS-10-1-mmddyy</td>
<td>TBD</td>
<td>1</td>
<td>1</td>
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</tbody>
</table>
### TABLE 5.2-3
**Request for Analyses - Sediment Analysis**
**ASARCO LLC Hayden Plant Smelter**

<table>
<thead>
<tr>
<th>UP-11</th>
<th>NE of Tailings Pond D - surface (0-2&quot;)</th>
<th>UP-SS-11-0-mmddyy</th>
<th>TBD</th>
<th>Low</th>
<th>1</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NE of Tailings Pond D - subsurface (10-12&quot;)</td>
<td>UP-SS-11-1-mmddyy</td>
<td>TBD</td>
<td>Low</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>UP-12</td>
<td>N-central of Tailings Pond D - surface (0-2&quot;)</td>
<td>UP-SS-12-0-mmddyy</td>
<td>TBD</td>
<td>Low</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>N-central of Tailings Pond D - subsurface (10-12&quot;)</td>
<td>UP-SS-12-1-mmddyy</td>
<td>TBD</td>
<td>Low</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>UP-13</td>
<td>NW of Tailings Pond D - surface (0-2&quot;)</td>
<td>UP-SS-13-0-mmddyy</td>
<td>TBD</td>
<td>Low</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>NW of Tailings Pond D – subsurface (10-12&quot;)</td>
<td>UP-SS-13-1-mmddyy</td>
<td>TBD</td>
<td>Low</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th><strong>Total Samples</strong></th>
<th>85</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Total Duplicates</strong></td>
<td>9</td>
</tr>
<tr>
<td></td>
<td><strong>Total Equipment Blanks</strong></td>
<td>~15 days (1/day)</td>
</tr>
<tr>
<td></td>
<td><strong>Total Trip Blanks</strong></td>
<td>0</td>
</tr>
<tr>
<td></td>
<td><strong>Total Laboratory QC (MS/MSD) Samples</strong></td>
<td>10</td>
</tr>
<tr>
<td></td>
<td><strong>Total Analyses</strong></td>
<td>119</td>
</tr>
</tbody>
</table>

Notes:

- **ASTM** American Society for Testing and Materials
- **CLP** contract laboratory program
- **DUP** duplicate sample
- **EPA** Environmental Protection Agency
- **FPXRF** field portable x-ray fluorescence
- **Hg** mercury
- **Lab QC MS/MSD** matrix spike/matrix spike duplicate (sample set which will be twice the normal sample volume)
- **pH** potential of hydrogen
- **TAL** target analyte list
- **TBD** to be determined (likely early spring 2006)
- **TPH** total petroleum hydrocarbons

mmddyy refers to sampling date

mmddyy indicates well or sample designation name should be followed by month, date and year denoting date of sample collection

All samples will be analyzed for TAL Inorganics. Other analytes will be determined at a later date. Locations of duplicates and MS/MSD are also being determined.
**TABLE 5.2-4A**  
Request for Analyses – Surficial Soil Analysis – Phase I  
ASARCO LLC Hayden Plant Smelter  

<table>
<thead>
<tr>
<th>Anticipated Laboratory Performing Analysis</th>
<th>CLP</th>
<th>FIELD</th>
<th>EPA Regional Lab</th>
</tr>
</thead>
<tbody>
<tr>
<td>Method</td>
<td>CLP / EPA 160mod</td>
<td>FPXRF</td>
<td>ASTM D 4539 / EPA 9045</td>
</tr>
<tr>
<td>Specific Analyses Requested</td>
<td>TAL Inorganics / Percent Solids</td>
<td>TAL Metals</td>
<td>Total Organic Carbon / pH</td>
</tr>
<tr>
<td>Preservatives</td>
<td>Chill to 4°C</td>
<td>None</td>
<td>Chill to 4°C</td>
</tr>
</tbody>
</table>

### Analytical Holding Time

- <28 days for Hg <6 months for others / immediately for pH
- <28 days for Hg <6 months for others / immediately for pH

### Contract Holding Time

- Bottles / Analysis
- 8 oz. poly bottle
- 8 oz. poly bottle
- 4 oz. glass bottle

#### San Pedro Wash

<table>
<thead>
<tr>
<th>Location ID</th>
<th>Sample Location</th>
<th>Sample ID1</th>
<th>Conc.</th>
<th>QA/QC Samples</th>
<th>Longitude2</th>
<th>Latitude2</th>
<th>Depth Interval</th>
<th>Bottles / Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPW-SED-01AS-mmddyy-456789-M5</td>
<td>Low MSD</td>
<td>W 110.7885122480</td>
<td>0 to 2&quot;</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SPW-SED-02AS-mmddyy</td>
<td>Low</td>
<td>W 110.7890369418</td>
<td>0 to 2&quot;</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SPW-SED-03AS-mmddyy</td>
<td>Low</td>
<td>W 110.7893261925</td>
<td>0 to 2&quot;</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SPW-SED-04AS-mmddyy</td>
<td>Low</td>
<td>W 110.7901304198</td>
<td>0 to 2&quot;</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SPW-SED-05AS-mmddyy</td>
<td>Low</td>
<td>W 110.7978539080</td>
<td>0 to 2&quot;</td>
<td>1</td>
<td>1</td>
<td>1</td>
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<td></td>
</tr>
<tr>
<td>SPW-SED-06AS-mmddyy</td>
<td>Low</td>
<td>W 110.7991767989</td>
<td>0 to 2&quot;</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
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<tr>
<td>SPW-SED-07AS-mmddyy</td>
<td>Low</td>
<td>W 110.7926401086</td>
<td>0 to 2&quot;</td>
<td>1</td>
<td>1</td>
<td>1</td>
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<td></td>
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<tr>
<td>SPW-SED-08AS-mmddyy</td>
<td>Low</td>
<td>W 110.7951456784</td>
<td>0 to 2&quot;</td>
<td>1</td>
<td>1</td>
<td>1</td>
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</tr>
<tr>
<td>SPW-SED-09AS-mmddyy</td>
<td>Low</td>
<td>W 110.7960371334</td>
<td>0 to 2&quot;</td>
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<td>1</td>
<td>1</td>
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<tr>
<td>SPW-SED-10AS-mmddyy</td>
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<td>W 110.7961557870</td>
<td>0 to 2&quot;</td>
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<td>1</td>
<td>1</td>
<td></td>
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</tr>
<tr>
<td>SPW-SED-11AS-mmddyy</td>
<td>Low</td>
<td>W 110.7978401064</td>
<td>0 to 2&quot;</td>
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<td>1</td>
<td>1</td>
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<tr>
<td>SPW-SED-12AS-mmddyy</td>
<td>Low</td>
<td>W 110.7916685346</td>
<td>0 to 2&quot;</td>
<td>1</td>
<td>1</td>
<td>1</td>
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<td></td>
</tr>
<tr>
<td>SPW-SED-13AS-mmddyy</td>
<td>Low</td>
<td>W 110.7919899798</td>
<td>0 to 2&quot;</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SPW-SED-14AS-mmddyy</td>
<td>Low</td>
<td>W 110.7926404740</td>
<td>0 to 2&quot;</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SPW-SED-15AS-mmddyy</td>
<td>Low</td>
<td>W 110.7917367304</td>
<td>0 to 2&quot;</td>
<td>1</td>
<td>1</td>
<td>1</td>
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</tr>
</tbody>
</table>

#### Power House Canyon

<table>
<thead>
<tr>
<th>Location ID</th>
<th>Sample Location</th>
<th>Sample ID1</th>
<th>Conc.</th>
<th>QA/QC Samples</th>
<th>Longitude2</th>
<th>Latitude2</th>
<th>Depth Interval</th>
<th>Bottles / Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHW-SED-01AS-mmddyy-456789-M5</td>
<td>Low MSD</td>
<td>W 110.7960749829</td>
<td>0 to 2&quot;</td>
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<td>1</td>
<td>1</td>
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<td></td>
</tr>
<tr>
<td>PHW-SED-02AS-mmddyy-456789-M5</td>
<td>Low MSD</td>
<td>W 110.7890369418</td>
<td>0 to 2&quot;</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PHW-SED-03AS-mmddyy</td>
<td>Low</td>
<td>W 110.7811714875</td>
<td>0 to 2&quot;</td>
<td>1</td>
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<tr>
<td>PHW-SED-04AS-mmddyy</td>
<td>Low</td>
<td>W 110.7815855170</td>
<td>0 to 2&quot;</td>
<td>1</td>
<td>1</td>
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<tr>
<td>PHW-SED-05AS-mmddyy</td>
<td>Low</td>
<td>W 110.7826767678</td>
<td>0 to 2&quot;</td>
<td>1</td>
<td>1</td>
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<td></td>
</tr>
<tr>
<td>PHW-SED-06AS-mmddyy</td>
<td>Low</td>
<td>W 110.7826767678</td>
<td>0 to 2&quot;</td>
<td>1</td>
<td>1</td>
<td>1</td>
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</table>
TABLE 5.2-4A
Request for Analyses - Surficial Soil Analysis – Phase I
ASARCO LLC Hayden Plant Smelter

<table>
<thead>
<tr>
<th>Anticipated Laboratory Performing Analysis</th>
<th>CLP</th>
<th>FIELD</th>
<th>EPA Regional Lab</th>
</tr>
</thead>
<tbody>
<tr>
<td>Method</td>
<td>CLP / EPA 160mod</td>
<td>FPXRF</td>
<td>ASTM D 4839 / EPA 9045</td>
</tr>
<tr>
<td>Specific Analyses Requested</td>
<td>TAL Inorganics / Percent Solids</td>
<td>TAL Metals</td>
<td>Total Organic Carbon / Ph</td>
</tr>
<tr>
<td>Preservatives</td>
<td>Chill to 4°C</td>
<td>None</td>
<td>Chill to 4°C</td>
</tr>
</tbody>
</table>

### Analytical Holding Time
- <28 days for Hg ≤ 0.1 mg/kg immediately for pH
- <6 months for others

### Contract Holding Time
- <28 days for Hg ≤ 0.1 mg/kg
- <6 months for others
- Immediately for pH

#### Total Samples
- 37
- 17
- 37

#### Total Duplicates
- 3
- 3
- 3

#### Total Equipment Blanks
- 2
- 2
- 2

#### Total Analyses
- 42
- 22
- 42

**NOTES:**
- **ASTM** American Society for Testing and Materials
- **C** Celsius
- **CLP** contract laboratory program
- **EPA** Environmental Protection Agency
- **FPXRF** field portable x-ray fluorescence
- **Hg** mercury
- **Lab QC MS/MSD** matrix spike/matrix spike duplicate (sample set which will be twice the normal sample volume)
- **pH** potential of hydrogen
- **TAL** target analyte list
- **mmddyy** refers to sampling date
- If a contingency sample is collected from 10 to 12 inches at any location, a “B” will replace “A” in the sample number (e.g., SPW-SED-1B-mmddyy).
- Set GPS Coordinate System to WGS84 Decimal-Degrees Lat-Long to use this table.
### TABLE 5.2-4B
Request for Analyses - Surficial Soil Analysis – Phase II
ASARCO LLC Hayden Plant Smelter

<table>
<thead>
<tr>
<th>Anticipated Laboratory Performing Analysis</th>
<th>CLP</th>
<th>FIELD</th>
<th>Contract</th>
<th>EPA Regional Lab</th>
<th>EPA Regional Lab</th>
<th>Contract</th>
<th>Contract</th>
</tr>
</thead>
<tbody>
<tr>
<td>Method</td>
<td>CLP</td>
<td>FPXRF</td>
<td>ASTM D4839</td>
<td>EPA 9045</td>
<td>EPA 160 mod</td>
<td>EPA 9081</td>
<td>ASTM C136</td>
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</table>

<table>
<thead>
<tr>
<th>Specific Analyses Requested</th>
<th>TAL Inorganics</th>
<th>TAL Metals</th>
<th>Total Organic Carbon</th>
<th>pH</th>
<th>Percent Solids</th>
<th>Cation Exchange Capacity</th>
<th>Grain Size Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preservatives</td>
<td>Chill to 4° C</td>
<td>None</td>
<td>Chill to 4° C</td>
<td>Chill to 4° C</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

| Analytical Holding Time                   | <28 days for Hg | <6 months for others | 28 days | Immediately | Immediately | None | None |

<table>
<thead>
<tr>
<th>Contract Holding Time</th>
<th>Bottles/Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample ID</td>
<td>Sample Location</td>
</tr>
<tr>
<td>Hayden Residential Properties h</td>
<td></td>
</tr>
<tr>
<td>Property #1</td>
<td>Surface soil #1</td>
</tr>
<tr>
<td>Surface soil #2</td>
<td>HSS-B-0-taxparcel #-mmddyy</td>
</tr>
<tr>
<td>Surface soil #2</td>
<td>HSS-B-0-taxparcel #-mmddyy-DUP</td>
</tr>
<tr>
<td>Surface soil #2</td>
<td>HSS-B-0-taxparcel #-mmddyy-MSD</td>
</tr>
<tr>
<td>Surface soil #2</td>
<td>HSS-B-0-taxparcel #-mmddyy-MSD</td>
</tr>
<tr>
<td>Surface soil #3</td>
<td>HSS-C-0-taxparcel #-mmddyy</td>
</tr>
<tr>
<td>Subsurface soil #1</td>
<td>HSS-x-1-taxparcel #-mmddyy</td>
</tr>
</tbody>
</table>

| Winkelman Residential Properties h         |                  |                |          |      |                   |                   |                   |                   |                   |
| Property #1                                | Surface soil #1  | WSS-A-0-taxparcel #-mmddyy | Low |
| Surface soil #2                            | WSS-B-0-taxparcel #-mmddyy | Low |
| Surface soil #2                            | WSS-B-0-taxparcel #-mmddyy-DUP | Low |
| Surface soil #2                            | WSS-B-0-taxparcel #-mmddyy-MSD | Low |
| Surface soil #2                            | WSS-B-0-taxparcel #-mmddyy-MSD | Low |
| Surface soil #3                            | WSS-C-0-taxparcel #-mmddyy | Low |
| Subsurface soil #1                          | WSS-x-1-taxparcel #-mmddyy | Low |

| Kennecott Avenue Wash                      |                  |                |          |      |                   |                   |                   |                   |                   |
| Various - 300’ grid                       | Surface soil/sediment | KAW-SED-1-mmddyy | Low |
| Various - 300’ grid                       | Surface soil/sediment | KAW-SED-2-mmddyy | Low |
| Various - 300’ grid                       | Surface soil/sediment | KAW-SED-3-mmddyy | Low |
| Various - 300’ grid                       | Surface soil/sediment | KAW-SED-4-mmddyy | Low |
| Various - 300’ grid                       | Surface soil/sediment | KAW-SED-5-mmddyy | Low |
| Various - 300’ grid                       | Surface soil/sediment | KAW-SED-6-mmddyy | Low |
| Various - 300’ grid                       | Surface soil/sediment | KAW-SED-7-mmddyy | Low |
### TABLE 5.2-4B
Request for Analyses - Surficial Soil Analysis – Phase II
ASARCO LLC Hayden Plant Smelter

<table>
<thead>
<tr>
<th>Anticipated Laboratory Performing Analysis</th>
<th>Method</th>
<th>Specific Analyses Requested</th>
<th>Preservatives</th>
<th>Analytical Holding Time</th>
<th>Contract Holding Time</th>
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**Preservatives**

- Chill to 4° C
- None

**Analytical Holding Time**

- <28 days for Hg
- <6 months for others
- 28 days
- Immediately

**Contract Holding Time**

- Bottles/Analysis:
  - 8 oz. poly bottle
  - 8 oz. poly bottle
  - 8 oz. poly bottle
  - 8 oz. poly bottle

**Sample ID**

- Various - 300’ gnd
- Surface soil/sediment
- KAW-SED-6-mmddyy
- Low

- Former Kennecott Smelter Area

- Various - 300’ gnd
- Surface soil/sediment
- KAW-SED-10-mmddyy
- Low

- Downstream of Slag Dump

- Various - 300’ gnd
- Surface soil/sediment
- SDD-SED-1-mmddyy
- Low

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### TABLE 5.2-4B
Request for Analyses – Surficial Soil Analysis – Phase II

**ASARCO LLC Hayden Plant Smelter**

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<td>Percent Solids</td>
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<td>Percent Solids, Cation</td>
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</table>

### Notes:
- **ASTM**: American Society for Testing and Materials
- **C**: Celsius
- **CLP**: contract laboratory program
- **DUP**: duplicate sample
- **EPA**: Environmental Protection Agency
- **FPXRF**: field portable x-ray fluorescence
- **Hg**: mercury
- **Lab QC MS/MSD**: matrix spike/matrix spike duplicate (sample set which will be twice the normal sample volume)
- **pH**: potential of hydrogen
- **TAL**: target analyte list
- **TBD**: To be Determined

Other analytes will be determined at a later date. Locations of duplicates and MS/MSD are also being determined.
### TABLE 5.2-5

**Request for Analyses - Indoor Residential and Attic Dust Analyses**

**ASARCO LLC Hayden Plant Smelter**

<table>
<thead>
<tr>
<th>Anticipated Laboratory Performing Analysis</th>
<th>CLP</th>
<th>EPA Regional Lab</th>
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#### Analytical Holding Time

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#### Contract Holding Time

- 6 months for others
- <30 days until extraction and 4 days after

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<th>House Sample Number</th>
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<th>Sample IDa</th>
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<td>HI01-mmddyy</td>
<td>Once</td>
<td>Low</td>
</tr>
<tr>
<td>HI01Dup</td>
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</tr>
<tr>
<td>HI03</td>
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</tr>
<tr>
<td>HI04</td>
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<td>WA10-mmddyy</td>
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</table>

| Total Samples       | 40  | 40  |
| Total Duplicates    | 4   | 4   |
| Total Equipment Blanks | 4  | 4  |
| Total Trip Blanks   |     |     |
| Total Laboratory QC (MS/MSD) Samples | 4 | 4 |
| Total Analyses      | 48  | 48  |

**Notes:**
- **C** = Celsius; **CLP** = Contract Laboratory Program; **DUP** = Duplicate Sample; **EPA** = Environmental Protection Agency; **Lab QC MS/MSD** = Matrix Spike/Matrix Spike Duplicate (sample set which will be twice the normal sample volume); **TAL** = target analyte list; **mmddyy** refers to sampling date
### TABLE 5.2-6
Request for Analyses - Ambient Air Monitoring
ASARCO LLC Hayden Plant Smelter

| Anticipated Laboratory Performing Analysis | CLP |
| Method | EPA IO-3/6010/6020 |
| Specific Analyses Requested | TAL Metals and PM<sub>10</sub> |
| Preservatives | No higher than 70 degrees F |
| Analytical Holding Time | 180 Days |
| Contract Holding Time | |
| Containers | 47 mm Filters |

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<th>Monitor Number</th>
<th>Sample Location</th>
<th>Sample ID&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Schedule</th>
<th>Conc.</th>
<th>Notes</th>
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<tr>
<td>Hayden-MY</td>
<td>Hayden Maintenance Yard</td>
<td>MY-mmddyy</td>
<td>Every 6th day and high wind days&lt;sup&gt;b&lt;/sup&gt;</td>
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<tr>
<td>Winkelman-HS</td>
<td>High School Gym Roof</td>
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<td>Every 6th day and high wind days&lt;sup&gt;b&lt;/sup&gt;</td>
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Total Samples 120
Total Duplicates NA
Total Equipment Blanks NA
Total Trip Blanks NA
Total Laboratory QC (MS/MSD) Samples NA
Total Analyses 120

Notes:
- CLP contract laboratory program
- EPA Environmental Protection Agency
- F Fahrenheit
- Lab QC MS/MSD matrix spike/matrix spike duplicate (sample set which will be twice the normal sample volume)
- NA Not available (due to nature of the sampling procedure, additional volume for these analyses will not be possible)
- TAL Target Analyte List
- mmddyy refers to sampling date
- 1 High wind day triggered if wind speed exceeds 14 mph. High wind samples are not included in the count.
### TABLE 5.2-7
Request for Analyses - Investigation Derived Soil Waste Analyses
ASARCO LLC Hayden Plant Smelter

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<th>CLP</th>
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<td>EPA 1311/CLP</td>
<td>EPA 1311/CLP</td>
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<td>Reactivity</td>
<td>Corrosivity</td>
<td>Ignitability</td>
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<td>Chill to 4°C</td>
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### Contract Holding Time

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<th>1x8 oz glass jar</th>
<th>1x8 oz glass jar</th>
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Notes:
- **C**: Celsius
- **CLP**: contract laboratory program
- **D**: duplicate sample
- **EPA**: Environmental Protection Agency
- **IDW**: investigation derived soil waste
- **Lab QC MS/MSD**: matrix spike/matrix spike duplicate (sample set which will be twice the normal sample volume)
- **SVOC**: semi volatile organic compound
- **TCLP**: Toxicity Characteristic Leaching Program
- **VOC**: volatile organic compound
### Investigation Derived Water Waste Analyses

<table>
<thead>
<tr>
<th>Anticipated Laboratory Performing Analysis</th>
<th>Method</th>
<th>CLP</th>
<th>CLP</th>
<th>CLP</th>
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<tr>
<td>Specific Analyses Requested</td>
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<td></td>
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<td>Preservatives</td>
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</tr>
<tr>
<td>Analytical Holding Time</td>
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<td></td>
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<tr>
<td>Contract Holding Time</td>
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<td></td>
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<td></td>
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<tr>
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<td>Sample ID</td>
<td>Schedule</td>
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<tr>
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</tr>
<tr>
<td>GW-05B IDW-L-GW-05B-[poly tank no.]</td>
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<td>Total Samples</td>
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<td></td>
</tr>
<tr>
<td>Total Duplicates</td>
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<tr>
<td>Total Equipment Blanks</td>
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<tr>
<td>Total Trip Blanks</td>
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<td>Total Analyses</td>
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</tr>
</tbody>
</table>

**NOTES:**
- **C** = Celsius
- **CLP** = contract laboratory program
- **Hg** = mercury
- **Lab QC MS/MSD** = matrix spike/matrix spike duplicate (sample set which will be twice the normal sample volume)
- **TCL** = target compounds list
- **TBD** = To be Determined

May use same poly tank for multiple well installations; naming scheme may change to reflect this.
Section 6  Field Methods and Procedures

This section of the FSP provides information on field activities associated with various media sampling events called for in the RI Workplan. This section contains the following subsections:

6.I  Groundwater
6.II  Surface Water and Sediment
6.III  Surficial Soil Sampling
6.IV  Indoor Dust Sampling
6.V  Attic Sampling
6.VIA  Ambient Air Monitoring
6.VIB  Ambient Air Monitoring-Acids
6.VII  Geotechnical Evaluation
6.VIII  Surveying and Mapping
6.IX  Ecological Investigation
6.X  Investigation Support Activities and Investigation-Derived Waste Sampling

The field activities to be performed for each media sampling event include the following, which are described in each subsection:

• Field equipment and measurements
• Sample collection
• Use of sample containers and preservatives
• Decontamination
• Containment and disposal of investigation-derived wastes
• Sample management and documentation
• Quality control sample collection
6.1 Groundwater

6.1.1 Well Installation

6.1.1.1 Field Notebooks and Forms

Pertinent field activities will be recorded in bound field notebooks and boring log forms. All information will be recorded in ink; errors will be crossed out and initialed. Notes will include, but are not limited to:

- Names of all personnel involved in the field activities
- Date of work
- Description of work to be performed
- General description of weather conditions
- Field instruments calibration information
- Subcontractors present
- Potential responsible party representatives names
- Visitors to the Site
- Reference to any photographs taken
- Signatures of persons making log entries
- Location of each sampling point
- Date and time of sample collection
- Observations of sampling procedure
- Legible corrections, which will be single lines through the error, signed and dated by the person making the correction
- Name, address, and telephone number of the contracted analytical laboratory
- Field observations and descriptions of problems encountered or changes made to the original plan

Copies of all necessary field forms (e.g., chain-of-custody (COC) forms, boring logs, etc.) will be kept in the field box. Working field forms, boring logs, note books and select supplies (e.g., sharpies) will be kept in a portable file box that will be kept at the Site during work hours. Once a well or task is complete, these files will be returned to the office for filing. At the completion of each day, the sign-off sheet will be completed, which lists the pertinent items listed on the bid schedule.
6.I.1.2 Drilling and Logging

Three lithologic units that will be encountered during the drilling operations include the following:

- Wash alluvium consisting of Holocene alluvium, slag, and artificial fill
- Gila River alluvium consisting of Holocene deeper Tertiary sediments consisting mainly of sand, gravel, and cobbles
- Big Dome Formation (bedrock) consisting of Tertiary age basin fill conglomerate

Drilling Techniques

All borings will be advanced by conventional air rotary or Air Rotary Casing Hammer (ARCH), or similar method. The method will be decided upon from receipt of bids from the drilling companies and evaluation of the terrain at the selected well sites.

Soil Sampling

Soil samples for lithologic logging for all wells will be collected from the cyclone using a shovel at five-foot intervals.

Lithologic Logging

Lithologic observations will be recorded on CH2M HILL’s standard boring log. The alluvium will be described using the Unified Soil Classification System (USCS) and ASTM D2488. The format and order for soil descriptions will be as follows:

1. USCS soil name with appropriate modifiers
2. Group symbol
3. Color (name and Munsell Chart code if available)
4. Moisture content (appropriate during ARCH, but not appropriate during mud rotary operations)
5. Relative density or consistency (if appropriate)
6. Dominant grain sizes and their relative percentages (all field staff should have a grain size card to facilitate consistent logging)
7. Angularity, plasticity, or other descriptors

Additional information that may be recorded on the boring logs include:

- The time each sample is collected (24-hour clock)
- Behavior of the drill rig (e.g., depths where difficult drilling occurs due to boulders, excessive fluid loss, poor or sporadic recovery of gravels, etc.)
- Drilling activities (e.g., bit changes, trip-outs, downtime, etc.)

6.I.1.3 Monitoring Well Construction

Well construction activities will be documented in field notebooks. All depths for well construction will be relative to ground surface. Field staff will maintain a tally that summarizes the type of each piece of casing installed, the location of centralizers (if needed), and supplies used. The well construction information will be transferred to an appropriate well construction diagram.
All wells will be installed at a target depth of approximately 50 to 100 feet using ARCH techniques. The requirements for drilling and construction of each well are as follows:

GW-1: drill to bedrock and set well approximately one foot off bedrock using a 20-foot well screen

GW-2: drill to bedrock and set well approximately one foot off bedrock using a 20-foot well screen

GW-3: drilling and well placement will mimic current well construction in the adjacent well field

GW-4: drill through bedrock until 30-feet below water table and set well using a 20-foot screen

GW-5: drill until 30-feet below water table and set well using a 20-foot screen

GW-6: drill to bedrock and set well approximately one foot off bedrock using a 20-foot well screen.

The proposed well completion details for these wells are as follows:

- Drilling Method
- Well Diameter: minimum 8-inch diameter
- Total Depth: approximately 50 to 100 feet depending on lithology and depth to water
- Casing Material: 4-inch O.D. diameter Sch. 80 PVC
- Screen: 0.040 slotted Schedule 80 PVC screen
- Annular Materials: #6/9 Silica sand filter pack, transition sand, bentonite seal, and cement/bentonite annular seal
- Surface Completion: either a locking above-ground steel surface casing or a grade-level manhole cover

### 6.1.1.4 Monitoring Well Development

Monitoring wells will be developed at least 24 hours after the completion of all grouting activities. Well development will be conducted by swabbing with a surge-block, bailing with a bailer, and surge purging with a submersible pump. Field staff will describe (in the field notebook) the development methods and equipment used during each step of the development process, and will record relevant information on a well development form, including pumping rates and duration; frequency and duration of swabbing and surging cycles; and the volume of groundwater generated during each step of the development process.

If necessary, monitoring wells may be initially developed following installation of the filter pack if substantial settling of the filter pack is expected. Initial development will be performed for a period of at least one to two hours using bailing or pumping. A filter pack will be added if settlement occurs during development.

Turbidity, electrical conductivity, pH and temperature of the discharge will be monitored during development; development will continue until the field parameters stabilize (e.g., ±
10 percent electrical conductivity, ± 0.1 pH unit, ± 10% temperature) and the turbidity has decreased to asymptotic levels. Field staff will also record this information on a well development form.

6.1.1.5 Equipment Decontamination

Drilling equipment brought to the Site will be free of heavy mud, oil, or other contamination. This includes contaminant-free water tanks. The drilling equipment will be decontaminated prior to start of project, after each well location, and before equipment departs the Site upon project completion. The subcontractor will decontaminate all drilling equipment by steam cleaning and letting equipment air dry. Decontamination will occur at the location of each well following installation.

6.1.1.6 Health and Safety

An initial job safety meeting will be conducted to discuss hazards and safety issues connected with planned activities (~1 hour). Daily safety briefings (~5 to 10 minutes) will be held each morning prior to entering the field. Daily safety briefings will conducted by the Site Safety Coordinator. All employees and subcontractors will sign daily health and safety form acknowledging the tailgate meeting each day. In addition, all personnel (i.e., CH2M HILL, subcontractors, and visitors) will sign in and out on the Daily Site Personnel/Visitor Log Form.

Fieldwork is scheduled to be performed in Level D personal protective equipment (PPE). Level D PPE includes work clothing (coveralls where necessary), hard hat, safety glasses, steel-toed work boots, ear protection, leather gloves, latex/nitrile gloves, rain gear, etc.

Air monitoring will be conducted by CH2M HILL field team members in accordance with the HASP using a Miniram model PDM-3 or equivalent for dust-monitoring measurements initially, prior to work, and periodically during drilling. These measurements will be recorded in a table in the field notebook.

Field staff will also complete the following Health and Safety Self-Assessment checklists when appropriate:

- Drilling
- Fall Protection (specifically when the drillers must climb the mast)
- Forklift Operation
- Non-hazardous Waste Management

6.1.1.7 Subcontractor Management

The drilling contract and waste handling contract are on a fixed unit cost basis. To adequately track and control costs, field staff must collect subcontractor daily sheets, review them, and work out any inconsistencies between the subcontractor’s version of events and CH2M HILL’s on a daily basis. Field staff will maintain copies of daily records in the field box and provide the original copies to the Task Manager.
6.I.1.8 Surveying
A geodetic survey of the locations will be conducted within one week after the work has been completed.

6.I.1.9 Schedule
Work is scheduled to start on or about November 28, 2005 and continue until December 16, 2005.

In general, drilling and oversight tasks will be conducted on a 10 hours a day, 5 days a week basis and will take place from 6:00 AM to 4:00 PM, in accordance with local regulations. However, as dictated by project needs, the fieldwork may be performed on weekends.

**Milestone Completion Dates**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Submit Notice of Intention to Drill</td>
<td>November 14, 2005</td>
</tr>
<tr>
<td>Blue Stake Notification</td>
<td>2 weeks prior to drilling</td>
</tr>
<tr>
<td>Notification of Field Activities</td>
<td>2 weeks prior to drilling</td>
</tr>
<tr>
<td>Grubbing of monitor well locations as needed</td>
<td>1 week prior to drilling</td>
</tr>
<tr>
<td>Mobilization and equipment inspection</td>
<td>1 day prior to drilling</td>
</tr>
<tr>
<td>Drilling activities</td>
<td>December 2005</td>
</tr>
<tr>
<td>Well completion activities</td>
<td>January 2005</td>
</tr>
<tr>
<td>Survey of MW locations</td>
<td>Within 2 weeks following completion</td>
</tr>
</tbody>
</table>

6.I.1.10 Field Equipment List
- Brushes (similar to toilet brushes)
- Liquinox
- Decon equipment (Spray Bottles)
- 5-gallon buckets
- Paper towels
- Liquid hand soap
- Nitrile gloves
- Ziploc bags
- Trash bags
- Ice cooler for drinking water
- Ice and drinking water
- Water proof pens
- Water level Indicator
- Water Quality Meter(s) and calibration solution- pH, temperature, conductivity
- Plastic cups/cylinder for parameters

6.I.1.11 Safety Equipment
- HASP
- Traffic cones, as necessary
- Safety glasses
- Hardhat
• Orange vests, as necessary
• Steel toe boots
• Ear plugs
• First Aid kit
• Bloodborne pathogen kit
• Fire extinguisher (should also be one in each of the subcontractor’s vehicles)
• Work gloves (leather or cotton)
• Miniram model PDM-3 or equivalent

6.I.1.12 Paperwork

• Well drilling specifications (with figures)
• Field logbook
• Boring logs for adjacent wells
• Blue Stake ticket numbers for each location
• Important contact information
• Copy of ASTM D2488 Flow Chart for identifying soils
• Copy of USCS chart
• Permits
• Forms
  • Blank Soil Boring Logs
  • Blank Well Construction Diagrams
  • Blank Well Development Logs
  • Blank Bid Schedules (drilling and waste handling) for daily tally
  • Daily Tailgate Health and Safety Briefing Forms
  • Health and Safety Self-Assessment Checklists (various checklists)

6.I.2 Field Equipment and Measurements

6.I.2.1 List of Equipment Needed

• Sampling pump such as a Grundfos submersible pump, with appropriate discharge tubing
• 500-gallon water wagon to contain purge water (unless approval is received from the regulatory agency and property owner to discharge purge water to the ground)
• Photo-ionization Detector (PID) (MultiRae or similar)
• Flow-through cell or similar (minimum probes: pH, temperature, electrical conductivity)
• Calibration standards
• Electronic water level indicator
• Sampling spigot (for production wells)
• 6kW Generator
• Power extension cords
• Power control boards
• Laptop with sampling software (Forms II Lite)/printer/paper/power inverter
• Deionized water for decontamination and field blanks
• High Performance Liquid Chromatography (HPLC) water for field and equipment blanks volatile organic analysis (VOA)
• Decontamination equipment (buckets, spray bottles, brushes, alconox)
• Nitrile gloves/work gloves
• Safety glasses/orange vests/steel toe boots
• Sample bottles/coolers/ice (sample bottles should be pre-prepared with the appropriate preservative as specified in the QAPP)
• Logbook
• Discharge hoses
• 0.45 micron filters
• Tool bag
• Paper towels
• Ziploc or similar plastic bags
• COC forms
• Waterproof pens
• Well construction details
• Packaging tape, clear tape
• Batteries
• Rope

6.1.2.2 Calibration of Field Equipment

For water analyses, field equipment requiring calibration includes at a minimum: combination pH, electrical conductivity, and temperature meters and PID. The meters will be calibrated before the start of work and at the end of the sampling day. Any instrument “drift” from prior calibration should be recorded in a field notebook. Calibration will be in accordance with procedures and schedules outlined in the particular instrument’s operation manual. The calibration standards to be used for the combination pH meter are standard buffered solutions of pH 4, 7, and 10. Water temperature measurements will be made using the temperature mode of the digital readout combination pH meter.

Calibrated equipment will be uniquely identified by using either the manufacturer’s serial number or other means. A label with the identification number and the date when the next calibration is due will be physically attached to the equipment. If this is not possible, records traceable to the equipment will be readily available for reference. In addition, the results of calibrations and records of repairs will be recorded in a logbook.

Scheduled periodic calibration of testing equipment does not relieve field personnel of the responsibility of employing properly functioning equipment. If an individual suspects an equipment malfunction, the device shall be removed from service, tagged so that it is not inadvertently used, and the appropriate personnel notified so that a re-calibration can be performed or a substitute piece of equipment can be obtained.

Equipment that fails calibration or becomes inoperable during use will be removed from service and either segregated to prevent inadvertent use or tagged to indicate it is out of
calibration. Such equipment will be repaired and satisfactorily re-calibrated. Equipment that cannot be repaired will be replaced.

Results of activities performed using equipment that has failed re-calibration will be evaluated. If the activity results are adversely affected, the results of the evaluation will be documented, and the task manager and quality assurance/quality control (QA/QC) reviewer will be notified.

6.1.2.3 Field Measurements
At a minimum, CH2M HILL personnel will measure the following field parameters at the beginning of purging, after each purge volume, and just prior to sampling: pH, temperature, specific conductance, dissolved oxygen.

6.1.3 Groundwater Sampling Procedures
The CH2M HILL sampling personnel will collect field and QC samples for EPA. The sample locations are listed in Table 5.2-1 and shown in Figure 3-3. The locations for field duplicate samples will be selected to reflect a representative range of contaminant concentrations. The locations for duplicate samples will include: (1) wells that have historically been non-detect for the contaminants of concern; (2) wells that have detected concentrations, but which are below MCLs; (3) wells that have concentrations just above MCLs; and (4) wells that have concentrations significantly above MCLs (if these wells exist).

The following procedures will be used for collection of groundwater samples from monitoring wells with or without dedicated submersible pumps:

1. Measure depth to water in well to be sampled.
2. Record water level measurement in the Groundwater Sampling Field Data Logbook and calculate three well volumes as described in Section 6.1.3.1.
3. If well has a dedicated pump, connect pump to appropriate control board, and connect control board to the generator. Otherwise, use the sampling pump as described in Section 6.1.3.2.
4. Connect spigot to pump column. Connect discharge hose to spigot. String discharge hose to approved manhole or water wagon (or to ground surface if approved).
5. Purge monitor well in accordance with procedures described in Section 6.1.3.2.
6. After field parameters stabilize and three to five purge volumes of water have been removed, CH2M HILL will collect water samples for laboratory analysis from the sampling port.
   • Wear nitrile gloves while sampling.
   • While sampling ensure the flow is very slow to prevent bubbles and volatilization.
   • For VOC samples, create a meniscus, cap, shake, and check for sample bottle for air bubbles. If an air bubble is found greater than the size a pea, discard the sample and resample the flow.
7. Complete sampling and labeling according to Section 6.1.7.
8. Place samples on ice.
9. Decontaminate equipment according to the procedures outlined in Section 6.1.5.
10. Dispose of purge water according to the procedures outlined in Section 6.1.6.
11. Follow sample documentation and shipment guidelines outlined in Section 6.1.7.5.
12. Follow the QC requirements outlined in Section 6.1.8.

For samples collected from operating water supply wells, manifolds or from a drinking water tap, the following procedures will be used:

a. Water samples should be collected from the cold water tap, and any pre-treatment/treatment devices (such as aerators, screens or filters) should be detached prior to filtering.

b. If the water source is used routinely (several times throughout the course of a day), then the tap should be allowed to run for a minimum of 15 minutes prior to sampling. If the water source is not in routine use, then the tap should be allowed to run for a minimum of 30 minutes.

c. During sampling, the flow rate should be set so as to cause the minimum amount of aeration or splashing.

d. Observed field properties will be recorded throughout the purging process. In addition to the groundwater quality parameters, these properties will include the date and time of purging, estimated flow rate, estimated time, total purged volume and notes regarding the clarity, odor and other physical attributes of the water.

e. Collect samples in appropriate sample containers containing the appropriate preservative for the analysis required. No bubbles or headspace should remain in the sample container.

f. Complete sampling and labeling according to Section 6.1.7.

g. Cool and store samples with cold packs or on ice.

h. Follow sample documentation and shipment guidelines outlined in Section 6.1.7.5.

i. Follow the QC requirements outlined in Section 6.1.8.

6.1.3.1 Water-Level Measurements

Groundwater level measurements will be collected prior to purging using an electric water level indicator, which allows measurements to the nearest 0.01 foot. Groundwater level measurements will be collected from the monitoring wells listed in Table 5.2-1 and located on Figure 3-3.

The electric water-level indicator probe, measuring tape, and wire will be decontaminated prior to initial use, between well locations and at the end of each work day by unwinding the tape to a point at least 80 percent of the depth of the previous groundwater level.
measurement to assure the entire system is decontaminated. Wells will be opened prior to any measurements to allow the well to equilibrate to atmospheric pressure. Groundwater level measurements will be collected from marked measuring points or the top of the north side of the well casing if no measuring point has been pre-determined. Water level elevations will be recorded in the field book at the time of the measurement.

6.1.3.2 Well Sampling and Purging

Standard Well Purging

Wells will be sampled using portable submersible pumps, and will be purged prior to sampling. If the well casing volume is known, a minimum of three well casing volumes of water will be purged using a submersible pump. Clean flexible tubes will be used for groundwater extraction. Tubes will be decontaminated before use in each well, or new tubes will be used for each well. Pumps will be placed below the water table at a point approximately one-third the distance between the total depth of the well and the water table elevation to permit reasonable draw down while preventing cascading conditions.

Casing volumes will be calculated based on total well depth, static water level, casing diameter and total borehole diameter. One casing volume will be calculated as the sum of the volume of water within the casing and the volume of water in the gravel pack between the casing and the borehole wall:

\[ V = 7.48 \times \pi \times [r^2h_1 + n (R^2-r^2)(h_2)] \]

where:

- \( V \) is the volume of one well casing of water (1ft³ = 7.48 gallons);
- \( n \) is the porosity of the gravel pack (assumed to be 0.3);
- \( r \) is the radius of the casing (in feet);
- \( R \) is the radius of the borehole (in feet);
- \( h_1 \) is the total height of water in the casing (in feet);
- \( h_2 \) is the total height of the saturated gravel pack. If the static water level is above the top of the gravel pack, then the gravel pack is completely saturated and \( h_2 \) is taken to be the total height of the gravel pack. If the static water level is below the top of the gravel pack, then only part of the gravel pack is saturated, and \( h_2 \) is taken to be the height of water in the casing.

It is most important to obtain a representative sample from the well. Stable water quality parameter (temperature, pH and specific conductance) measurements indicate representative sampling is obtainable. Water quality is considered stable if for three consecutive readings:

- Temperature range is no more than ±1°C
- pH varies by no more than +/- 0.1 pH units
- Specific conductance readings are within +/- 3% of the average
- ORP values are within +/- 10% millivolts
• DO values are within +/- 0.3 milligrams per liter

The water in which measurements were taken will not be used to fill sample bottles.

If the well casing volume is known, measurements will be collected before the start of purging, and at the end of purging each casing volume. If water quality parameters are not stable after 5 casing volumes or 30 minutes, purging will cease, which will be noted in the logbook, and groundwater samples will be collected. If the well casing volume is NOT known, measurements will be taken at intervals of 2.5 minutes beginning when flow starts. The depth to water, water quality measurements and purge volumes will be entered in the logbook.

If a well dewatered before three casing volumes can be purged, that well will be allowed to recharge up to 80 percent of the static water column and pumped again until parameters stabilize and a sample can be collected. If the well dewatered again before purging three casing volumes and collecting samples, the well will again be allowed to recharge, and groundwater samples will be collected.

### 6.1.4 Sample Containers and Preservatives

The contracted analytical laboratory or vendor will provide the required sample containers for the samples. Containers will have been cleaned and certified to be free of the analytes of concern for this project. No sample containers will be reused. Preservatives, if required, will be added by CH2M HILL in the field. The adequacy of preservation will be verified by the laboratory upon receipt of the samples, and additional preservative will be added, if necessary. It will be CH2M HILL’s responsibility to obtain the appropriate sampling containers prior to sampling.

The containers, minimum sample quantities, required preservatives, and maximum holding times are shown in Table 5.2-1. Three times the sample quantities shown in these tables should be collected for samples designated for duplicate matrix spike analyses.

**Contract Laboratory Program (CLP) TCL Volatiles (VOCs).** Low concentration water samples to be analyzed for VOCs will be collected in 40-milliliters (mL) glass vials. Approximately 8-10 drops of 1:1 hydrochloric acid (HCL) will have been previously added to the vial by CH2M HILL personnel to maintain a pH of 2 when the bottle is filled. The vials will be filled so there is no headspace. The samples will be cooled to 4°C immediately upon collection. Three vials of each water sample are required.

**CLP Target Analyte List (TAL) Metals.** Water samples for metals analysis will be collected in 500-mL polyethylene bottles. The bottle will be preserved by adding approximately 54 drops of nitric acid (HNO₃) to the sample bottle, bringing the pH to 2 or below. The bottle will be capped and lightly shaken to mix in the acid. A small quantity of sample will be poured into the bottle cap where the pH will be measured using pH paper. The pH must be <2. The sample in the cap will be discarded, and the pH of the sample will be adjusted further if necessary. The samples will be cooled to 4°C immediately upon collection. One bottle of each water sample is required. A single 1-liter bottle may be used for this analysis and for hardness.
Chloride, Sulfate, Nitrate, Alkalinity, and TDS. Water samples collected for sulfate, nitrate, alkalinity, and TDS analysis will be collected in 500-mL polyethylene bottles. The samples will be cooled to 4°C immediately upon collection. One bottle of each water sample is required for each laboratory.

6.1.5 Decontamination

When dedicated equipment is not used for sampling, it must be decontaminated. Sampling personnel will decontaminate sampling equipment as described below. Field and sampling equipment that may contact samples must be decontaminated after each use.

The minimum decontamination procedure for sampling equipment will consist of the following:

- Wash the equipment with non-phosphate detergent.
- Rinse the equipment with tap water.
- Rinse the equipment with deionized/distilled water.

Equipment will be protected from dust and allowed to air-dry. Decontaminated equipment will not be allowed to touch contaminated surfaces. The equipment will be labeled as decontaminated for organic sampling, with the decontamination date included on the label.

At least one equipment blank will be collected after each sampling event to verify the effectiveness of the decontamination procedure. Section 6.1.8 of this FSP contains information related to QC samples.

Decontamination waste media will be collected, stored, and transported in approved containers. They will then be characterized for disposal according to state and local regulations.

6.1.6 Containment and Disposal of Investigation-Derived Waste (IDW)

In the process of collecting groundwater samples at the Site, the CH2M HILL sampling team will generate different types of potentially contaminated IDW that may include the following:

- Used PPE
- Disposable sampling equipment
- Decontamination fluids
- Purged groundwater and excess groundwater collected for sample container filling.

The EPA’s National Contingency Plan (NCP) requires that management of IDW generated during sampling comply with all applicable or relevant and appropriate requirements (ARARs) to the extent practicable. The sampling plan will follow the Office of Emergency and Remedial Response (OERR) Directive 9345.3-02 (May 1991), which provides the guidance for the management of IDW. In addition, other legal and practical considerations that may affect the handling of IDW will be considered.
• Used PPE and disposable equipment will be double bagged and placed in a municipal refuse dumpster. These wastes are not considered hazardous and can be sent to a municipal landfill. Any PPE and disposable equipment that is to be disposed of which can still be reused will be rendered inoperable before disposal in the refuse dumpster.

• Decontamination fluids that will be generated in the sampling event will consist of deionized water, residual contaminants, and water with non-phosphate detergent. The water (and water with detergent) will be poured into the 500-gallon water wagon and discharged into an approved sewer system.

Purge water will be contained either in 55-gallon drums or in a water wagon at the Site. The purge water will be discharged to ground surface if this approach is approved by the regulatory agencies and property owners. Otherwise, the purge water will then be discharged into an approved sewer system.

6.1.7 Sample Management Procedures and Documentation

6.1.7.1 Field Notes

Field notes for Site sampling activities may consist of logbooks, pre-printed field data sheets, COC forms, and photographs.

Field Logbooks

Sampling activities will be recorded in a bound field notebook. These notebooks are intended to provide sufficient data and observations to enable participants to reconstruct events that occurred during the project, and to refresh the memory of the field personnel if called upon to give testimony during legal proceedings. In a legal proceeding, notes, if referred to, are subject to cross-examination and are admissible as evidence. Entries must be dated, legible, written in permanent ink, and contain accurate and inclusive documentation of project activities. Language should be objective and factual. Legible corrections, which will be single lines through the error, signed and dated by the person making the correction. The field notebook must be maintained by each sampling team leader to provide a daily record of significant events, observations, and measurements during field investigations. Entries should be signed and dated. It should be kept as a permanent record.

The following will be recorded on the field data sheet:

• Sample location
• Names of all field team members
• Weather conditions
• Static depth to groundwater
• Field measurement/equipment calibration standard
• Purge method
• Purge rate and total gallons discharged
• Time that submersible pump is started
• Time that submersible pump is stopped
• Field parameters (at a minimum pH, temperature, and electrical conductivity)
• Physical characteristics of the water including color, odor, and presence of suspended solids
• Time of sample collection
• Blanks, duplicates, and QA/QC samples collected
• Number of containers collected, preservatives used, and analyses to be performed
• Laboratory the sample will be shipped to
• Purge water disposal location
• Comments or exceptions to the FSP/QAPP
• Reference to any photographs taken

6.1.7.2 Photographs
For each photograph taken, the following information will be written in the logbook or recorded in a separate field photography log:

• Time, date, location, and weather conditions
• Description of the subject photographed
• Name of person taking the photograph

6.1.7.3 Labeling
Each sample container will be labeled with a sample identification number, date of collection, time of collection, case number if required, type of analysis, and preservatives. Sample identification numbers and locations (including blanks and duplicates) will be recorded in the field notebook and field datasheet.

6.1.7.4 Sample Chain-of-Custody (COC) Forms and Custody Seals
When samples are shipped to the laboratory, they must be placed in containers sealed with custody seals. One or more custody seals must be placed on each side of the shipping container (cooler). COC forms will be filled out or generated using Forms II Lite for the collected samples as applicable.

COC procedures will be followed as described below to accomplish this task:

• The COC documentation will be completed using the information included on each sample label including a sample identification number, which will correspond to the well number, the date and time the sample was collected, case number, the initials of the sampler, identification of any preservatives used, the sampler’s affiliation, and the analysis requested.

• Additional information included on the COC will include the contact address, phone number, and fax number of the sampler and/or consultant project manager along with any special instructions or warnings for the laboratory.

• Each COC form will be signed by the sampler and again be signed by the laboratory official once the samples have been delivered. Courier names and other pertinent information are entered in the “Received by” section of the COC record.

• The COC will be included with each sample it documents until such time the samples have been delivered to the laboratory. The original COC accompanies the shipment to the laboratory. One copy of the COC will be retained in the project file, and another copy along with the archived database, will be sent to EPA.
If sent by mail, the package is registered with return requested. If sent by common carrier, a bill of lading is used. Freight bill, postal service receipts, and bills of lading are retained as part of the permanent documentation.

### 6.1.7.5 Packaging and Shipment

**Sample Containers**
1. Place a custody seal around each sample container cap.
2. Place sample vials and bottles for each water sample in the cooler. Glass sample bottles shall be covered with bubble wrap.

**Preparring the Sample Cooler**
1. Remove all previous labels used on cooler.
2. Seal all drain plugs (outside and inside).
3. Place a cushioning layer at bottom of cooler.
4. Double bag all ice in plastic bags and seal.

**Packing Samples in Coolers**
1. Place COC form in ziplock bag.
2. Place samples in upright position in cooler.
3. Fill void space between samples with cushioning material and/or ice.
4. Place ice on top of water samples and between samples.

**Closing of Cooler**
1. Tape cooler lid with strapping tape, encircling cooler several times.
2. Place COC seals on two sides of lid (suggest seal in front and side).
3. Place “This Side Up” arrows on sides of cooler.

Place the coolers or box containing samples upright on a flat, stable surface to avoid tipping and/or sliding during transport. Keep out of the sun entirely. Transport to the laboratory (or an overnight courier for shipment to the contracted laboratory) immediately upon completion of sample collection. Intermediate stops should be avoided, with the exception of emergencies only, in which case the situation should be noted in the field notebooks. If the samples are shipped via overnight courier, notify the laboratory that the samples are being shipped.

### 6.1.8 Quality Control Samples

The QC samples will be collected or prepared to assist in determining data reliability. These QC samples include field duplicates, field blanks, and laboratory QC samples (for matrix spike [MS] and matrix spike duplicates [MSDs]). The QC samples will be collected immediately following and using the same procedures as the collection of the target sample.

#### 6.1.8.1 Field Duplicates

The field duplicate is an independent sample collected as close as possible to the original sample from the same source and is used to document sampling precision. Field duplicates will be labeled and packaged in the same manner as other samples so that the laboratory
cannot distinguish between samples and duplicates. Field duplicates will be collected by alternately filling sample and sample duplicate containers at a location of known or suspected contamination. Each duplicate will be taken using the same sampling and preservation method as other samples. Field duplicates will be collected at a minimum frequency of one in every 10 samples. Table 5.2-1 presents the number of field duplicates expected to be collected during the scheduled sampling events.

6.1.8.2 Field Blanks

The field blanks are collected to verify that contamination is not introduced to samples during collection, handling, or shipping of the samples. They will be prepared by pouring blank water directly into the sample bottles (true field blanks) or by pouring blank water over or through decontaminated sampling equipment (equipment blanks). Commercially prepared HPLC water will be used for organic analyses and reagent-grade deionized water for inorganic analyses using the same preservation methods and packaging and sealing procedures used during collection of groundwater samples. Field blanks will be prepared and labeled in the same manner as the field samples and sent "blind" to the laboratory. A field blank will be collected at the first or last sampling location each day. Table 5.2-1 presents the number of and type of blank samples expected to be collected during the scheduled sampling events.

6.1.8.3 Laboratory QC Samples

Laboratory QC samples will be collected to perform MS and MSD analyses. An MS is an aliquot of a sample spiked with a known concentration of target analytes and provides a measure of the method accuracy. The MSD is a laboratory split sample of the MS, and is used to determine the precision of the method.

Twice the normal water volume will be collected for laboratory QC samples. Laboratory QC samples will be labeled as such on sample bottles and paperwork. The MS/MSDs will be collected at the discretion of the field crew, at a frequency of one in every 20 collected samples or one per week, whichever is greater. Table 5.2-1 presents the number of MS/MSDs expected to be collected during the scheduled sampling events.

6.1.8.4 Trip Blanks

Trip blanks will be used to assess the potential introduction of contaminants from sample containers or during the transportation and storage procedures. A trip blank consists of a VOC sample vial filled in the laboratory with HPLC-grade water, transported to the sampling site, handled like an environmental sample, and returned to the laboratory for analysis. Trip blanks are not opened in the field, are prepared only when VOC samples are collected, and analyzed only for VOCs. Table 5.2-1 presents the number of trip blanks expected to be collected during the scheduled sampling events.

6.1.8.5 Temperature Blanks

Temperature blanks will be included with each cooler shipment containing samples (regardless of targeted analysis) sent to the laboratory. A temperature blank consists of a VOC sample vial filled in the field with de-ionized water, handled like an environmental sample, and returned to the laboratory for analysis. The temperature blank provides a
means of verifying that samples have been maintained at the proper temperature (4 °C) following collection and during transport to the laboratory.
6.II  Surface Water and Sediment Sampling

This section of the FSP provides information on field activities associated with surface water and sediment sampling.

6.II.1 Field Equipment and Measurements

6.II.1.1 List of Equipment and Documentation Needed

**Surface Water**

The following materials and equipment will be necessary for measurement of field water quality parameters and collection of surface water samples for laboratory analysis:

- In-flow water quality meter (minimum probes: pH, temperature, electrical conductivity, and dissolved oxygen [DO])
- Calibration standards
- Spare pH or electrolyte cartridge, as applicable
- pH electrode storage location
- Deionized water for decontamination and field blanks
- HPLC water for field and equipment blanks
- Decontamination equipment (buckets, spray bottles, brushes, alconox)
- Nitrile gloves/work gloves
- Safety glasses/orange vests/steel-toe boots
- Reference Maps
- 100-foot tape measure
- Surveying stakes or flags for marking of sample locations
- Stopwatch
- Digital camera
- Trash bags
- Sample bottles/labels/coolers/ice
- Tygon™ or silicone tubing
- Peristaltic pump
- 12-volt battery
- Beakers of assorted sizes
Field personnel will document sample collection in the field logbook. Generally information to be documented includes sampling conditions, sample location and identification, and methods used. Photographs should be taken at each sampling location to document both the sample point and sampling conditions. Specifically, the following field notes will be recorded in the field book:

- Names of sampling personnel
- Weather conditions
- Date and time of sampling
- Sample location number
- Description of sampling location (e.g., surrounding Site description and sketch)
- Decontamination information
- Sampling method
- Sampler’s signature
- Observations of conditions that may affect sample quality

**Sediment**

The following materials and equipment may be necessary for the collection of sediment samples for laboratory analysis:

- FPXRF spectrometer and associated equipment (spare battery charger; polyethylene sample cups [31 millimeters (mm) to 40 mm in diameter with collar or equivalent; x-ray window fil [Mylar™, Kapton™, Spectrolene™, polypropylene, or equivalent 2.5 to 6.0 micrometers (um) thick; mortar and pestle for grinding samples; sample containers; 60-mesh sieves [stainless steel, nylon or equivalent] for preparing samples; trowels for smoothing soil surfaces; plastic bags; drying oven [standard convection or toaster oven])
- Laboratory-supplied sample containers
• Bound field logbook
• Reference maps
• 100-foot tape measure
• Camera and film
• Surveying stakes or flags for marking of sampling locations and GPS receiver
• Monitoring equipment and PPE as outlined in the HASP
• Decontamination equipment and supplies (e.g., wash/rinse tubs, brushes, Alconox, plastic sheeting, paper towels, sponges, baby wipes, garden-type water sprayers, large plastic bags, potable water, distilled water and/or deionized water)
• Stainless steel scoop or spoon, knife, pick and mixing bowl
• Sample collection supplies (e.g., plastic resealable plastic bags or equivalent, waterproof markers, sample labels, COC forms, cooler for sample storage, ice or ice substitute, clear plastic and strapping tape, custody seals, trash bags)
• Approved containers for containing soil and water
• Other materials and equipment may be needed based on field conditions

Field personnel will document sample collection in the field logbook. Generally information to be documented includes sampling conditions, sample location and identification, and methods used. Photographs should be taken at each sampling location to document both the sample point and sampling conditions. Specifically, the following field notes will be recorded in the field book:

• Names of sampling personnel
• Weather conditions
• Date and time of sampling
• Sample location number
• Description of sampling location (e.g., surrounding Site description and sketch, observation of staining, grain-size variability, sediment layering characteristics, colors, etc.)
• Sediment color according to Munsel soil color chart and grain size
• Decontamination information
• Sampling method
• Sampler’s signature
• Observations of conditions that may affect sample quality
6.II.1.2 Calibration of Field Equipment

**Surface Water**

For water analyses, field equipment requiring calibration includes: combination pH, electrical conductivity, temperature and DO meters. The meters will be calibrated before the start of work and at the end of the sampling day. Any instrument “drift” from prior calibration should be recorded in a field notebook. Calibration will be in accordance with procedures and schedules outlined in the particular instrument’s operation manual. The calibration standards to be used for the combination pH meter are standard buffered solutions of pH 4, 7 and 10. Water temperature measurements will be made using the temperature mode of the digital readout combination pH meter.

Calibrated equipment will be uniquely identified by using either the manufacturer’s serial number or other means. A label with the identification number and the date when the next calibration is due will be physically attached to the equipment. If this is not possible, records traceable to the equipment will be readily available for reference. In addition, the results of calibrations and records of repairs will be recorded in a logbook.

Scheduled periodic calibration of testing equipment does not relieve field personnel of the responsibility of employing properly functioning equipment. If an individual suspects an equipment malfunction, the device shall be removed from service, tagged so that it is not inadvertently used, and the appropriate personnel notified so that a re-calibration can be performed or a substitute piece of equipment can be obtained.

Equipment that fails calibration or becomes inoperable during use will be removed from service and either segregated to prevent inadvertent use or tagged to indicate it is out of calibration. Such equipment will be repaired and satisfactorily re-calibrated. Equipment that cannot be repaired will be replaced.

Results of activities performed using equipment that has failed re-calibration will be evaluated. If the activity results are adversely affected, the results of the evaluation will be documented, and the task manager and QA/QC reviewer will be notified.

**Sediment**

Instrument calibration procedures vary among FPXRF instruments. Users of this method should follow the calibration procedures outlined in the operator’s manual for each specific FPXRF instrument.

Calibrated equipment will be uniquely identified by using either the manufacturer’s serial number or other means. A label with the identification number and the date when the next calibration is due will be physically attached to the equipment. If this is not possible, records traceable to the equipment will be readily available for reference. In addition, the results of calibrations and records of repairs will be recorded in a logbook.

Scheduled periodic calibration of testing equipment does not relieve field personnel of the responsibility of employing properly functioning equipment. If an individual suspects an equipment malfunction, the device shall be removed from service, tagged so that it is not inadvertently used, and the appropriate personnel notified so that a re-calibration can be performed or a substitute piece of equipment can be obtained.
Equipment that fails calibration or becomes inoperable during use will be removed from service and either segregated to prevent inadvertent use or tagged to indicate it is out of calibration. Such equipment will be repaired and satisfactorily re-calibrated. Equipment that cannot be repaired will be replaced.

Results of activities performed using equipment that has failed re-calibration will be evaluated. If the activity results are adversely affected, the results of the evaluation will be documented, and the task manager and QA/QC reviewer will be notified.

6.II.1.3 Field Measurements

Surface Water

Several of the field parameters are physically or chemically unstable and may be tested using either an in-flow multi-measurement system or a field-test kit or instrument, immediately after sample collection. Examples of unstable parameters include pH, temperature and DO. Although the conductivity of a substance is relatively stable, the characteristic needs to be measured in the field to compare with the laboratory measurement to determine if significant dissolution or precipitation has occurred after sample collection. Most instruments measuring conductivity require temperature compensation. Therefore, the temperature of the samples will be measured at the time the conductivity is measured.

At a minimum, CH2M HILL personnel will measure the following field parameters prior to sampling: pH, temperature, specific conductance and DO. In addition, conductivity measurements will be collected at 50 to 100-foot intervals along the Gila River within the project area. This conductivity survey will be completed with the same instrument and procedure as used to measure conductivity at specific sample sites defined in the RI Work Plan.

An unfiltered water grab sample (if not employing an in-flow multi-measurement system) will be collected for measuring field parameters. One sample will be used to measure all field parameters, but field parameters need to be measured as soon as possible after collection and this unfiltered sample should not be submitted for laboratory analysis. The field parameters will be measured in the following order, as applicable:

- Temperature and pH
- Conductivity
- DO
- Turbidity
- Salinity

The in-flow multi-parameter monitoring system or similar multi-parameter instruments may be used for measuring pH, temperature, conductivity and DO. The instrument operation and maintenance manual will be followed when operating or calibrating the instrument.
Sediment

XRF analyses will be performed on sediment samples. Samples from locations where FPXRF screening indicates elevated concentrations will be submitted for laboratory analyses, at a frequency of 10 percent. An exception to this ratio of XRF to laboratory analyses is that all sediment samples collected from the discrete sampling locations shown on Figure 3-4 (including samples from background/upland areas, co-located surface water and sediment samples, tailings sediment samples, and samples from stable riparian areas) will be submitted for laboratory analyses following XRF analyses; with the exception of those sites where the concentrations of all metals measured by the XRF exceed the detection limits of the XRF. Samples containing concentrations of all metals above XRF detection limits will not be submitted for laboratory analyses. The XRF detection limits for metals are in most cases above threshold ecological risk criteria. Therefore, laboratory analyses are necessary to support an ecological risk assessment by quantifying metals concentrations above threshold ecological risk criteria, and below XRF detection limits. In addition, the first phase of the study will include the collection of sediment samples in discrete areas and analysis of all samples using FPXRF and laboratory analysis, to help establish a correlation between the field and laboratory data. Based on a statistical evaluation from this first phase of work, the 10 percent frequency may be adjusted such that a larger number of samples are submitted for laboratory analysis.

Use of the XRF method is restricted to personnel trained and knowledgeable in the operation of an FPXRF instrument or under the supervision of a trained and knowledgeable individual. Proper training for the safe operation of the FPXRF instrument and radiation training should be completed by the supervising analyst prior to the analysis. Radiation safety for each specific instrument can be found in the operator’s manual. Protective shielding should never be removed by the analyst or any personnel other than the manufacturer. The analyst should be aware of the local state and national regulations that pertain to the use of radiation-producing equipment and radioactive materials with which compliance is required. Radiation monitoring equipment should be used with the handling of the instrument. The operator and the surrounding environment should be monitored continually for analyst exposure to radiation. Thermal luminescent detectors (TLD) in the form of badges and rings are used to monitor operator radiation exposure.

An FPXRF spectrometer consists of four major components: (1) a source that provides x-rays; (2) a sample presentation device; (3) a detector that converts x-ray-generated photons emitted from the sample into measurable electronic signals; and (4) a data processing unit that contains an emission or fluorescence energy analyzer that processes the signals into an x-ray energy spectrum from which elemental concentrations in the sample may be calculated, and a data display and storage system.

Operation of the various FPXRF instruments will also vary according to the manufacturer’s protocols. Before operating any FPXRF instrument, one should consult the manufacturers’ manual. Most manufacturers recommend that their instruments be allowed to warm up for 15 to 30 minutes before analysis of samples. This will help alleviate drift or energy calibration problems later on in analysis.

For measurements, the sample is positioned in front of the probe window. This can be done in two manners using FPXRF instruments; in situ or intrusive. If operated in the in situ
mode, the probe window is placed in direct contact with the sediment surface to be analyzed. For in situ analysis, any large or non-representative debris should be removed from the sediment surface before analysis. This debris includes rocks, pebbles, leaves, vegetation, roots and concrete. The sediment surface should also be as smooth as possible so that the probe window will have good contact with the surface. This may require some leveling of the surface with a stainless-steel trowel.

When an FPXRF instrument is operated in the intrusive mode, a soil or sediment sample must be collected, prepared and placed in a sample cup. The sample cup is then placed on top of the window inside a protective cover for analysis. For intrusive analysis of sediment, it is recommended that a sample be collected from a 4 by 4-inch square that is 1 inch deep. This will produce a sediment sample of approximately 375 grams or 250 cubic centimeter (cm³), which is enough sediment to fill an 8-ounce jar. Ideally, the sample should be homogenized, dried, and ground before analysis.

Every effort should be made to thoroughly mix and homogenize sediment samples before analysis. For the best results, the window of the probe should be in direct contact with the sample, which means that the sample should be flat and smooth to provide a good contact surface. The measurement time of each source is user-selectable. Shorter source measurement times (30 seconds) are generally used for initial screening and hot spot delineation, and longer measurements (up to 300 seconds) are typically used to meet higher precision and accuracy requirements.

Sample analysis is initiated by exposing the sample to primary radiation from the source. Fluorescent and backscattered x-rays from the sample enter through the detector window and area converted into electric pulses in the detector. The detector in FPXRF instruments is usually either a solid-state detector or a gas-filled proportional counter.

Most FPXRF instruments have software capable of storing all analytical results and spectra. The results are displayed in parts per million and can be downloaded to a personal computer (PC), which can provide a hard copy printout. Individual measurements that are smaller than three times their associated standard deviation (SD) should not be used for quantitation.

Additional procedures for sample collection and analysis using the FPXRF are provided in EPA Method 6200 included in Appendix A – Field Standard Operating Procedures.

### 6.II.2 Sampling Procedures

#### Surface Water

The paragraphs below describe procedures for collection of surface water samples from the Gila and San Pedro Rivers and from the two tailings ponds, including both samples collected for laboratory analysis as well as field measurements of water quality parameters. Both total (unfiltered) and dissolved (filtered) surface water samples will be analyzed for TAL metals, which include: aluminum, antimony, arsenic, barium, beryllium, boron, cadmium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, molybdenum, nickel, selenium, silver, thallium, uranium, vanadium and zinc.
Surface water flow conditions vary at the Site. Flows in the Gila River are largely controlled by releases from storage facilities located upstream, and the San Pedro River flows intermittently based largely on precipitation. Surface water flow conditions expected to be encountered at the Site include:

- Areas of standing water;
- Flowing streams and ditches; and
- Low flow seeps and springs.

Separate sampling procedures are specified for each of the three flow condition types. Sediment samples will in some instances be co-located with surface water samples. Surface water samples will be collected prior to sediment samples to avoid effects from sediment disturbance.

The personnel performing sampling activities will have knowledge and experience in the sampling methods proposed or will work under the direct field supervision of knowledgeable and experienced personnel.

**Standing Water Sampling Procedures**

Samples may be collected by direct submersion of the sample bottle in the standing water if the sample bottles provided by the laboratory do not contain preservatives. If the bottles contain preservatives, a transfer container must be used to initially collect the sample of the standing water prior to transferring the sample to the container submitted to the laboratory. The procedures for collection of standing surface water samples are as follows:

1. Rinse the laboratory-supplied sample bottle or transfer device three times with standing water before collecting the sample (discard rinse water well away from the sample location).

2. Submerge the laboratory-supplied sample bottle or decontaminated transfer container below the water surface, taking care to minimize disturbance of bottom materials. If possible, the sample should be collected from at least six inches below the water surface.

3. Fill the laboratory-supplied sample bottle to the required volume (either by submersion or from the transfer container). The filtering procedure for the dissolved metals/parameters is described in a separate section below. Cap and appropriately label the total and dissolved samples.

4. The laboratory will be supplying bottles with appropriate preservatives, but if necessary, add the appropriate preservative to the sample.

5. Place the samples for shipping to the laboratory in accordance with the sample handling procedures described in Section 6.II.2.

6. Collect a sample of the standing water in the transfer container and measure field parameters in accordance with Section 6.II.2. Record field measurements in the field logbook and discard the water.
Flowing Water Sampling Procedures

Samples may be collected by direct submersion of the sample bottle in the flowing water if the sample bottles provided by the laboratory do not contain preservatives. If the bottles contain preservatives, a transfer container must be used to initially collect the sample of the flowing water prior to transferring the sample to the container submitted to the laboratory. The procedures for collection of flowing surface water samples are as follows:

1. To avoid disturbing stream sediments that may affect the sample, approach the sampling location from downstream. Always stand downstream of each individual sampling location while collecting the sample. When collecting samples at successive locations in the river, always proceed from downstream to upstream locations.

2. If a transfer container is to be used, triple rinse the container with flowing water prior to collecting the sample. Discard the rinse water downstream of the sampling location.

3. Fill the laboratory-supplied sample bottle to the required volume (either by submersion or from the transfer container). If possible, the sample should be collected from at least six inches below the water surface. The filtering procedure for the dissolved metals/parameters is described in a separate section below. Cap and appropriately label the total and dissolved samples.

4. The laboratory will be supplying bottles with appropriate preservatives, but if necessary, add the appropriate preservative to the sample.

5. Place the samples for shipping to the laboratory in accordance with the sample handling procedures described in Section 6.II.2.

6. Collect a sample of the standing water in the transfer container and measure field parameters in accordance with Section 6.II.2. Record field measurements in the field logbook and discard the water.

Low Flow Sampling Procedures

The procedures for collection of low flow surface water samples are as follows:

1. Dig a small depression in the soil adjacent to and within the path of flow.

2. Place a decontaminated stainless steel bowl in the depression with the rim of the bowl positioned to intercept the flow.

3. Allow the bowl to fill and to overflow for several minutes (preferably until the water is no longer turbid).

4. Obtain water samples from the stainless steel bowl by submerging the sample bottle or using a decontaminated transfer container (triple rinse the sample container prior to sample collection). The filtering procedure for the dissolved metals/parameters is described in a separate section below. Cap and appropriately label the total and dissolved samples.

5. The laboratory will be supplying bottles with appropriate preservatives, but if necessary, add the appropriate preservative to the sample.
6. Place the samples for shipping to the laboratory in accordance with the sample handling procedures described in Section 6.II.2.

7. Collect a sample of the standing water in the transfer container and measure field parameters in accordance with Section 6.II.2. Record field measurements in the field logbook and discard the water.

**Filtering Procedures**

The procedures for filtering surface water samples using an in-line filter and peristaltic pump are as follows:

- Assemble the filter and peristaltic pump according to the manufacturer’s instructions. Insert a new piece of tubing about six inches long through the pump head of the peristaltic pump. New tubing will also be used for each sample.

- Place the unfiltered water sample into the decontaminated sample transfer device such as a large beaker. Place the inlet tube into the sample transfer device and turn on the pump.

- Rinse and discard the first 25-100 mL of water that passes through the tubing and filter. The volume should be approximately three times the tubing volume.

- Use the discharge line from the pump to fill the appropriate sample container(s) with filtered water.

- Place the used filter and tubing in a suitable container and dispose of as IDW.

The following procedure is used for filtering samples using a hand pump:

1. Assemble the filter unit according to the manufacturer’s instructions. Use a new filter unit for each sample.

2. Pour the unfiltered water sample into the top portion of the filter unit. Use the hand pump to apply pressure to the filter unit to increase the rate of filtration.

3. Discard the first 25 mL of water that passes through the filter.

4. Transfer the filtered sample from the lower portion of the filter unit to the appropriate sample container(s) with filtered water.

5. Place the used filter unit in a suitable container and dispose of as IDW.

**Sediment - Bulk**

The sediment sampling protocol is as follows:

1. At each location, clear an area approximately 12 inches in diameter of surface vegetation and other non-representative debris.

2. Use an uncontaminated stainless steel spoon to collect the sediment to the desired depth. A stainless steel pick may be used as needed to loosen the sediment. To the extent possible, eliminate gravel or larger sized particles, vegetation or debris based on visual observation. Collect sufficient sample volume to meet analytical requirements.
3. Place the sample in a stainless steel bowl. To the extent possible, eliminate gravel or larger sized particles, vegetation or debris based on visual observation.

4. Thoroughly mix the sample material in the stainless steel bowl using a decontaminated stainless steel spoon.

5. Immediately fill the appropriate sample containers. Label and handle the containers as specified in Section 6.II.6.

6. Decontaminate the sampling equipment in accordance with procedures presented in Section 6.II.2.

**Sediment – Dust**

At selected locations, a dust fraction of the sediment sample will be collected and submitted separately for laboratory analysis. The dust fraction will be obtained using a 200-mesh sieve. This sampling protocol is as follows:

1. Immediately adjacent to the bulk fraction sample location, clear an area approximately 12 inches in diameter of surface vegetation and other non-representative debris.

2. Use an uncontaminated stainless steel spoon to collect the sediment to the desired depth. A stainless steel pick may be used as needed to loosen the sediment. To the extent possible, eliminate gravel or larger sized particles, vegetation or debris based on visual observation. Collect sufficient sample volume to meet analytical requirements.

3. Place the sample in a stainless steel bowl. To the extent possible, eliminate gravel or larger sized particles, vegetation or debris based on visual observation.

4. Thoroughly mix the sample material in the stainless steel bowl using a decontaminated stainless steel spoon.

5. Pass the sample through a decontaminated 200-mesh sieve, and collect the resulting sample in a stainless steel bowl.

6. Immediately fill the appropriate sample containers. Label and handle the containers as specified in Section 6.II.6.

7. Decontaminate the sampling equipment in accordance with procedures presented in Section 6.II.2.

**6.II.3 Sample Containers and Preservatives**

**Surface Water**

The contracted analytical laboratory or vendor will provide the required sample containers for the samples. Containers will have been cleaned and certified to be free of analytes of concern for this project. No sample containers will be reused. Preservatives, if required, will be added by CH2M HILL in the field if the bottles are not pre-preserved. The adequacy of preservation will be verified by the laboratory upon receipt of the samples, and
additional preservatives will be added, if necessary. It will be CH2M HILL’s responsibility to obtain the appropriate sampling containers prior to sampling. Water samples for metals analysis will be collected in 500 mL polyethylene bottles (one unfiltered sample collected in a 500 mL bottle for total metals and one filtered sample collected in a 500 mL bottle for dissolved metals). The bottles will be preserved by adding approximately 54 drops of (HNO₃) to the sample bottle, bringing the pH to 2 or below. The bottle will be capped and lightly shaken to mix in the acid. A small quantity of sample will be poured into the cap where the pH will be measured using pH paper. The pH must be \( \leq 2 \). The sample in the cap will be discarded, and the pH will be adjusted if necessary. The samples will be cooled to 4°C immediately upon collection. One bottle of each water sample is required.

### Sediment

The contracted analytical laboratory or vendor will provide the required sample containers for the samples. Containers will have been cleaned and certified to be free of analytes of concern for this project. No sample containers will be reused. It will be CH2M HILL’s responsibility to obtain the appropriate sampling containers prior to sampling. Two times the normal sample quantity will be collected for samples designated as duplicate analysis and three times the normal sample quantity will be collected for samples designated for MS analysis. Sediment samples collected for metals analysis will be collected in one 8 ounce polyethylene bottle at each sample location. The samples will be cooled to 4°C immediately upon collection.

### 6.II.4 Decontamination

#### Surface Water and Sediment

Sampling personnel will decontaminate sampling equipment as described below. Field and sampling equipment that may contact samples must be decontaminated after each use.

The minimum decontamination procedure for sampling equipment will consist of the following:

- Wash the equipment with non-phosphate detergent.
- Rinse the equipment with tap water.
- Rinse the equipment with deionized/distilled water.

Equipment will be protected from dust and allowed to air dry. Decontaminated equipment will not be allowed to touch contaminated surfaces. The equipment will be labeled as decontaminated for organic sampling, with the decontamination date included on the label.

At least one equipment blank will be collected after each sampling event to verify the effectiveness of the decontamination procedure. Section 6.II.2 of this FSP contains information related to QC samples.

Decontamination waste media will be collected, stored and transported in approved containers. They will then be characterized for disposal according to state and local regulations.
6.II.5 Containment and Disposal of Investigation-Derived Waste (IDW)

Surface Water and Sediment
In the process of collecting samples, the CH2M HILL sampling team will generate different types of potentially contaminated IDW that may include the following:

- Used PPE
- Disposable sampling equipment
- Decontamination fluids

The EPA’s NCP requires that management of IDW generated during sampling comply with all ARARs to the extent practicable. The sampling plan will follow the OERR Directive 9345.3-02 (May 1991), which provides the guidance for the management of IDW. In addition, other legal and practical considerations that may affect the handling of IDW will be considered.

- Used PPE and disposable equipment will be double bagged and placed in a municipal refuse dumpster. These wastes are not considered hazardous and can be sent to a municipal landfill. Any PPE and disposable equipment that is to be disposed of which can still be reused will be rendered inoperable before disposal in the refuse dumpster.

- Decontamination fluids that will be generated in the sampling event will consist of deionized water, residual contaminants, and water with non-phosphate detergent. The water (and water with detergent) will be poured into portable containers for subsequent collection and disposal.

6.II.6 Sample Management Procedures and Documentation

Surface Water and Sediment

6.II.6.1 Field Notes
Field notes for Site sampling activities may consist of logbooks, COC forms, and photographs.

Field Logbooks
Sampling activities will be recorded in a bound field logbook. These logbooks are intended to provide sufficient data and observations to enable participants to reconstruct events that occurred during the project, and to refresh the memory of the field personnel if called upon to give testimony during legal proceedings. In a legal proceeding, notes, if referred to, are subject to cross-examination and are admissible as evidence. Entries must be dated, legible, written in permanent ink, and contain accurate and inclusive documentation of project activities. Language should be objective and factual. Legible corrections, which will be single lines through the error, signed and dated by the person making the correction. The field logbook must be maintained by each sampling team leader to provide a daily record of
significant events, observations, and measurements during field investigations. Entries should be signed and dated. It should be kept as a permanent record.

The following will be recorded in the field logbook:

- Names of sampling personnel
- Weather conditions
- Date and time of sampling
- Sample location number
- Description of sampling location (e.g., surrounding Site description and sketch, [observation of staining, grain-size variability, sediment layering characteristics and colors for sediment only], etc.)
- Sediment color according to Munsel soil color chart and grain size
- Decontamination information
- Sampling method
- Sampler’s signature
- Observations of conditions that may affect sample quality

6.II.6.2 Photographs

For each photograph taken, the following information will be written in the logbook or recorded in a separate field photography log:

- Time, date, location, and weather conditions
- Description of the subject photographed
- Name of person taking the photograph

6.II.6.3 Labeling

Each sample container will be labeled with a sample identification number, date of collection, time of collection, case number if required, type of analysis, and preservatives. Sample identification numbers and locations (including blanks and duplicates) will be recorded in the field notebook and field datasheet.

6.II.6.4 Sample Chain-of-Custody (COC) Forms and Custody Seals

When samples are shipped to the laboratory, they must be placed in containers sealed with custody seals. One or more custody seals must be placed on each side of the shipping container (cooler). COC forms will be filled out or generated using Forms II Lite for the collected samples as applicable.

COC procedures will be followed as described below to accomplish this task:

- The COC documentation will be completed using the information included on each sample label including a sample identification number, the date and time the sample
was collected, case number, the initials of the sampler, identification of any preservatives used, the sampler’s affiliation, and the analysis requested.

- Additional information included on the COC will include the contact address, phone number, and fax number of the sampler and/or consultant project manager along with any special instructions or warnings for the laboratory.

- Each COC form will be signed by the sampler and again be signed by the laboratory official once the samples have been delivered. Courier names and other pertinent information are entered in the “Received by” section of the COC record.

- The COC will be included with each sample it documents until such time the samples have been delivered to the laboratory. The original COC accompanies the shipment to the laboratory. One copy of the COC will be retained in the project file and another copy along with the archived database will be sent to EPA.

If sent by mail, the package is registered with return requested. If sent by common carrier, a bill of lading is used. Freight bill, postal service receipts, and bills of lading are retained as part of the permanent documentation.

6.II.6.5 Packaging and Shipment

Sample Containers
- Place a custody seal around each sample container cap.
- Place sample vials and bottles for each sample in the cooler. Glass sample bottles shall be covered with bubble wrap.

Preparing the Sample Cooler
- Remove all previous labels used on cooler.
- Seal all drain plugs (outside and inside).
- Place a cushioning layer at bottom of cooler.
- Double bag all ice in plastic bags and seal.

Packing Samples in Coolers
- Place COC form in ziplock bag.
- Place samples in upright position in cooler.
- Fill void space between samples with cushioning material and/or ice.
- Place ice on top of water samples and between samples.

Closing of Cooler
- Tape cooler lid with strapping tape, encircling cooler several times.
- Place COC seals on two sides of lid (suggest seal in front and side).
- Place “This Side Up” arrows on sides of cooler.

Place the coolers or box containing samples upright on a flat, stable surface to avoid tipping and/or sliding during transport. Keep out of the sun entirely. Transport to the laboratory (or an overnight courier for shipment to the contracted laboratory) immediately upon completion of sample collection. Intermediate stops should be avoided, with the exception of emergencies only, in which case the situation should be noted in the field notebooks. If
the samples are shipped via overnight courier, notify the laboratory that the samples are being shipped.

6.II.7 Quality Control Samples

Surface Water and Sediment
The QC samples will be collected or prepared to assist in determining data reliability. These QC samples include field duplicates, field blanks, and laboratory QC samples for MS and MSDs. The QC samples will be collected immediately following and using the same procedures as the collection of the target sample.

6.II.7.1 Field Duplicates
The field duplicate is an independent sample collected as close as possible to the original sample from the same source and is used to document sampling precision. Field duplicates will be labeled and packaged in the same manner as other samples so that the laboratory cannot distinguish between samples and duplicates. Field duplicates will be collected by alternately filling sample and sample duplicate containers at a location of known or suspected contamination. Each duplicate will be taken using the same sampling and preservation method as other samples. Field duplicates will be collected at a minimum frequency of one in every 10 samples. Tables 5.2-2 and 5.2-3 shows the field duplicates.

6.II.7.2 Laboratory QC Samples
Laboratory QC samples will be collected to perform MS and MSD analyses. An MS is an aliquot of a sample spiked with a known concentration of target analytes and provides a measure of the method accuracy. The MSD is a laboratory split sample of the MS, and is used to determine the precision of the method.

Twice the normal sample volume will be collected for laboratory QC samples. Laboratory QC samples will be labeled as such on sample bottles and paperwork. The MS/MSDs will be collected at the discretion of the field crew, at a frequency of one in every 20 collected samples. Tables 5.2-2 and 5.2-3 presents the number of MS/MSDs expected to be collected during the scheduled sampling events.

6.II.7.3 Field Blanks
The field blanks are collected to verify that contamination is not introduced to samples during collection, handling, or shipping of the samples. They will be prepared by pouring blank water directly into the sample bottles (true field blanks) or by pouring blank water over or through decontaminated sampling equipment (equipment blanks). Reagent-grade deionized water will be used for inorganic analyses using the same preservation methods and packaging and sealing procedures used during collection of other samples. Field blanks will be prepared and labeled in the same manner as the field samples and sent "blind" to the laboratory. A field blank will be collected at the last sampling (equipment) location each day.
6.II.7.4 Temperature Blanks

Temperature blanks will be included with each cooler shipment containing samples (regardless of targeted analysis) sent to the laboratory. A temperature blank consists of a VOC sample vial filled in the field with de-ionized water, handled like an environmental sample, and returned to the laboratory for analysis. The temperature blank provides a means of verifying that samples have been maintained at the proper temperature (4 °C) following collection and during transport to the laboratory.
6.III  Surficial Soil Sampling

This section of the FSP provides information on procedures associated with surficial soil sampling.

6.III.1  Field Equipment and Measurements

6.III.1.1  List of Equipment and Documentation Needed

The following materials and equipment may be necessary:

- XLt 700 series FPXRF spectrometer and associated equipment (spare battery charger; polyethylene sample cups [31 mm to 40 mm] in diameter with collar or equivalent; x-ray window fil [Mylar™, Kapton™, Spectrolene™], polypropylene, or equivalent 2.5 to 6.0 um thick; mortar and pestle for grinding samples [although these will not likely be used for this sampling event]; sample containers; 10-mesh, 60-mesh, and 120-mesh sieves [stainless steel, nylon or equivalent] for preparing samples; trowels for smoothing soil surfaces; plastic bags; and drying oven [standard convection or toaster oven if needed for moist soil conditions]).

- GPS receiver
- Laboratory-supplied sample containers
- Bound field logbook
- Reference maps
- 100-foot tape measure
- Camera and film
- Surveying stakes or flags for marking of sampling locations and GPS receiver
- Monitoring equipment and personal protective equipment (PPE) as outlined in the HASP
- Decontamination equipment and supplies (e.g., wash/rinse tubs, brushes, Alconox, plastic sheeting, paper towels, sponges, baby wipes, garden-type water sprayers, large plastic bags, potable water, distilled water and/or deionized water)
- Stainless steel scoop or spoon, knife, pick and mixing bowl
- Mesh sieves (at a minimum, 10-mesh, 60-mesh and 120-mesh) to collect samples of ore dust fractions (dust fractions are that material which passes the 200 sieve, although it may not be possible for a sufficient volume of sample needed for FPXRF or laboratory analysis to pass through this sieve size)
- Sample collection supplies (e.g., plastic resealable plastic bags or equivalent, waterproof markers, sample labels, COC forms, cooler for sample storage, ice or ice substitute, clear plastic and strapping tape, custody seals, trash bags)
• Approved containers for containing soil and water
• Other materials and equipment may be needed based on field conditions

Field personnel will document sample collection in the field logbook. Generally, information to be documented includes sampling conditions, sample location and identification, and methods used. Photographs should be taken at each sampling location to document both the sample point and sampling conditions. Specifically, the following field notes will be recorded in the field book:

• Names of sampling personnel
• Weather conditions
• Date and time of sampling
• Sample location number
• Description of sampling location (e.g., surrounding Site description and sketch, observation of staining, odors, grain-size variability, soil layering characteristics, colors, etc.)
• Soil color according to Munsel soil color chart and grain size
• Decontamination information
• Sampling method
• Sampler’s signature
• Observations of conditions that may affect sample quality

6.III.1.2 Project Telephone Numbers

The following table includes all telephone numbers pertinent to conducting the surficial soils investigation.

<table>
<thead>
<tr>
<th>Name</th>
<th>Project Role</th>
<th>Office Phone</th>
<th>Cell Phone</th>
<th>Office</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kevin Murdock</td>
<td>Project Manager</td>
<td>480-966-8188 x6246</td>
<td>480-205-9099</td>
<td>Phoenix</td>
</tr>
<tr>
<td>Artemis Antipas</td>
<td>QA Manager</td>
<td>245-453-5000 x5051</td>
<td>206-419-0926</td>
<td>Seattle</td>
</tr>
<tr>
<td>Donna Roraback</td>
<td>Field Team Leader</td>
<td>480-377-6269</td>
<td>602-295-4092</td>
<td>Phoenix</td>
</tr>
<tr>
<td>Oscar Sorensen</td>
<td>Task Manager</td>
<td>720-286-0241</td>
<td>720-219-9503</td>
<td>Denver</td>
</tr>
<tr>
<td>Gretchen Engel</td>
<td>Database Manager</td>
<td>480-377-6235</td>
<td>480-239-4468</td>
<td>Phoenix</td>
</tr>
</tbody>
</table>

6.III.1.3 Field Measurements

Gamma Ray Survey Procedures

A gamma ray survey will be conducted at the Site focusing on areas around the perimeter of the facility, around the large tailings piles and former in-town tailings piles (located within lower Kennecott Avenue and Power House Canyon Wash drainages), along the highway in Winkelman, along the railroad tracks, and along the San Pedro Wash as appropriate. In
addition, selected residential yards will be included in the survey. Use of this method is restricted to personnel trained and knowledgeable in the operation of a gamma ray survey instrument or under the supervision of a trained and knowledgeable individual.

Instrument calibration procedures vary among gamma ray survey instruments. Users of this method should follow the calibration procedures outlined in the operator’s manual for each specific gamma ray survey instrument.

Sodium iodide survey meters (NAI (T1) detectors) are normally used for scanning areas for gamma emitters because they are very sensitive to gamma radiation, easily portable and relatively inexpensive. The detector is held close to the ground surface (~3 inches) and moved in a serpentine (i.e., snake like, “S” shape) pattern while walking at a speed that allows the investigator to detect the desired investigation level. A scan rate of approximately 0.5 meters per second (m/s) is typically used for distributed gamma emitting contaminants in soil; however, this rate must be adjusted depending on the expected detector response and the desired investigation level.

The gamma ray survey will include a walkover survey of the areas mentioned above using a scalar rate meter, such as the Ludlum 2221, which has been used at other mining sites. The Ludlum 2221 contains an unshielded 3” x 3” sodium iodide detector that detects and counts gamma rays and identifies radionuclides using an Exploranium GR-130 Gamma Spectrum Analyzer. During the walkover survey, the detector will be suspended approximately three inches above the surface to ensure accuracy and representativeness. Any anomalous areas will be subjected to a 60 second count initially, and the counts would be verified using a 600 second count with the Ludlum meter as well as the Exploranium. Using both instruments during the verification count provides both verification of the count as well as identification of the radionuclides present. Additional information describing the gamma ray survey procedure can be found in an EPA document titled *Multi-Agency Radiation Survey and Site Investigation Manual* (MARSSIM), EPA document 402-R-97-016/NUREG-1575 (EPA, 1997).

Following completion of the gamma ray survey, areas with elevated gamma ray counts may be included in the soil sampling program. The soil sampling procedures are described in Section 6.III.2.

**Field-Portable X-Ray Fluorescence (FPXRF) Procedures**

FPXRF analyses will be performed on samples collected from 0-2” (all locations) and 10-12” (depending on the location). For the Phase I sampling event, all samples will be analyzed by FPXRF and submitted for laboratory analyses, in order to establish a correlation between the data sets. No heavy equipment will be used to collect subsurface samples.

Use of this method is restricted to personnel trained and knowledgeable in the operation of an FPXRF instrument or under the supervision of a trained and knowledgeable individual. Proper training for the safe operation of the FPXRF instrument and radiation training should be completed by the analyst prior to the analysis. Radiation safety for each specific instrument can be found in the operator’s manual. Protective shielding should never be removed by the analyst or any personnel other than the manufacturer. The analyst should be aware of the local state and national regulations that pertain to the use of radiation-producing equipment and radioactive materials with which compliance is required.
An FPXRF spectrometer consists of four major components: (1) a source that provides x-rays; (2) a sample presentation device; (3) a detector that converts x-ray-generated photons emitted from the sample into measurable electronic signals; and (4) a data processing unit that contains an emission or fluorescence energy analyzer that processes the signals into an x-ray energy spectrum from which elemental concentrations in the sample may be calculated, and a data display and storage system.

Instrument calibration procedures vary among FPXRF instruments. Users of this method should follow the calibration procedures outlined in the operator’s manual for the XLt 700 FPXRF instrument and the established guidelines in EPA method 6200.

Operation of the various FPXRF instruments will also vary according to the manufacturer’s protocols. Before operating any FPXRF instrument, one should consult the manufacturers’ manual. Most manufacturers recommend that their instruments be allowed to warm up for 15 to 30 minutes before analysis of samples. This will help alleviate drift or energy calibration problems later on in analysis.

For measurements, the sample is positioned in front of the probe window. This can be done in two manners using FPXRF instruments; in situ or intrusive. If operated in the in situ mode, the probe window is placed in direct contact with the soil surface to be analyzed. For in situ analysis, any large or non-representative debris should be removed from the soil surface before analysis. This debris includes rocks, pebbles, leaves, vegetation, roots and concrete. The soil surface should also be as smooth as possible so that the probe window will have good contact with the surface. This may require some leveling of the surface with a stainless-steel trowel.

When an FPXRF instrument is operated in the intrusive mode, a soil or sediment sample must be collected, prepared as described above, and placed in a sample cup. The sample cup is then placed on top of the window inside a protective cover for analysis. For intrusive analysis of surface soil or sediment, it is recommended that a sample be collected from a 4 by 4-inch square that is 2 inches deep. This will produce a soil sample of approximately 750 grams or 500 cm³, which is enough soil to fill a 16-ounce jar (this will allow sufficient sample for FPXRF analysis and laboratory analysis). The sample should be homogenized and dried, if needed, based on observed moisture content. The samples will be analyzed in their current condition and will not be ground before analysis. The sample cups used for analysis will be retained in the field office for possible future analysis.

Every effort should be made to thoroughly mix and homogenize soil samples before analysis. For the best results, the window of the probe should be in direct contact with the sample, which means that the sample should be flat and smooth to provide a good contact surface. The measurement time of each source is user-selectable. Shorter source measurement times (30 seconds) are generally used for initial screening and hot spot delineation, and longer measurements (up to 300 seconds) are typically used to meet higher precision and accuracy requirements. Therefore, for purposes of this project, the longer measurement times (at least 120 seconds) will be implemented.

Sample analysis is initiated by exposing the sample to primary radiation from the source. Fluorescent and backscattered x-rays from the sample enter through the detector window
and area converted into electric pulses in the detector. The detector in FPXRF instruments is usually either a solid-state detector or a gas-filled proportional counter.

Most FPXRF instruments have software capable of storing all analytical results and spectra. The results are displayed in parts per million and can be downloaded to a PC, which can provide a hard copy printout. Individual measurements that are smaller than three times their associated SD should not be used for quantitation.

Additional procedures for sample collection and analysis using the FPXRF are provided in EPA Method 6200; attached for reference.

6.III.2 Soil Sampling Procedures

The paragraphs below describe procedures for collection of surficial soil samples to be submitted to a laboratory for analysis. These samples will be analyzed for Total Organic Carbon (TOC), Percent Solids, pH and TAL metals, which includes: aluminum, antimony, arsenic, barium, beryllium, boron, cadmium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, molybdenum, nickel, selenium, silver, thallium, uranium, vanadium and zinc. Figure 3-5 includes a map of the Hayden-Winkelman area where samples will be collected during the Phase I and Phase II soil investigations. Figure 3.5a includes a detailed map of samples to be collected during the Phase I soil investigation. Tables 5.2-4A (Phase I) and 5.2-4B (Phase II) provide sample locations and sample-specific details.

The purpose of the Phase I sampling event is to establish a correlation between the FPXRF and laboratory analyses. During the Phase I soil sampling event, surficial soil samples will be collected from San Pedro Wash and Powerhouse Canyon Wash, located to the west and east of Hayden, respectively (Figure 3.5a). An estimated 15 samples will be collected in each wash (based on a 300-foot grid) from 0- to 2-inches below ground surface (bgs). Contingency samples will be collected from 10- to 12-inches at locations displaying staining or elevated (defined as concentrations of any metal which exceed five times the Arizona R-SRL) detections using the FPXRF. Each sample will be located using a handheld GPS coupled with Tables 5.2-4A and 5.2-4B, which contains the coordinates for each soil sample location. The GPS must be set to the World Geodetic System, 1984 (WGS84) using Latitude and Longitude in decimal-degree format.

The phase II sampling will consist of residential sampling and sampling in all other areas included on Figure 4-1 from the Workplan, which will include:

1. Residential yards of all habitable homes (occupied and un-occupied) within Hayden and Winkelman, including homes that have been sampled during previous studies.
2. Former Kennecott smelter area (including smelter yard, Smelter Last Chance Pond, slag pile, landfill, and other disturbed areas);
3. Kennecott Avenue Wash and the conveyor wash area, including side slopes adjacent to the washes and extending to the limit of residential yards;
4. Soils in the vicinity of the crusher facility, and on the western side of the concentrator facilities (adjacent to public areas in Hayden);
5. Developed land adjacent to the rail line and State Highway 177 (north of Tailings Pile AB/BC) and extending along the main highway through Winkelman;

6. Ore and ore dust associated with No. 9 Conveyor;

7. Dust in attics and occupied areas of selected habitable homes within Hayden and Winkelman, as described in Section 4.3.5;

8. Upland areas representing different wind directions;

9. Winkelman school area;

10. Public park area east of Winkelman;

11. Golf course and access road east of AB/BC Ponds; an

12. Drainage areas immediately downstream of the slag dump located southeast of the active smelter.

Access agreements must be obtained before any sampling is conducted.

Sampling in residential areas will include habitable residential yards of all residences in Hayden and Winkelman. For the residential yard and school area soil samples, four samples will be collected; two surface soil samples (0-2”) in high use areas; one subsurface soil (10-12”) in one of the two same high use areas; and one surface soil sample (0-2”) from a non-high use area. The high use area will be selected as that area where outdoor activity appears to be concentrated (i.e., front or back porch area, near a picnic table or swingset, etc.). If only one or no high use areas are identified, then one sample should be collected near a gutter or downspout; other samples will be at the discretion of the Field Team Leader. If the home has a small lot, only two surface and one subsurface samples may be required.

At each sampling location, soil will be sampled following removal of surface vegetation and other debris from the sampling area. Prior to sampling, the volume of sample material to be collected will be calculated. The sampling protocol for samples to be submitted to a laboratory for analysis is as follows:

1. Identify the sampling site and mark it with a flag, lath or surveying stake.

2. At each location, clear an area approximately 12-24 inches in diameter of surface vegetation and debris.

3. Use a decontaminated stainless steel spoon to collect the surface soil at the discrete depth intervals identified in the RI Work Plan. A stainless steel pick may be used as needed to loosen the soil. To the extent possible, eliminate gravel or larger-sized particles, organic matter or other debris based on visual observation. Record and document by photograph the vertical stratigraphy of the soil sample location. If windblown material overlies the natural soil, this material should be collected as a separate sample at the soil sample locations. Describe the soil type and color using a Munsell color chart. Collect sufficient sample volume to enable the associated analyses.
4. Place the sample in a stainless steel bowl. To the extent possible, eliminate gravel or larger-sized particles, organic matter or other debris based on visual observation. Record a description of the sample in the field notebook, including color using the Munsell chart.

5. Thoroughly mix the sample material in the stainless steel bowl using a decontaminated stainless steel spoon.

6. Immediately fill the appropriate sample containers. Label and handle the containers as specified in Section 6.III.6. Soil samples collected at FPXRF-analyzed locations are to be thoroughly homogenized and analyzed by XRF. The FPXRF will provide real-time measurements of concentrations in soil for a total of about 25 analytes. All analytes will be stored and a limited number may be reported, at the discretion of EPA. Laboratory instructions are to include a stipulation that all soils are to be thoroughly homogenized immediately prior to acquiring the sample for chemical analysis.

7. Contingency samples may be collected at locations where surficial soil samples demonstrate visible staining and/or elevated (five times Arizona R-SRLs) detections using the FPXRF. If a contingency sample is collected, utilize the stainless steel spoon used to collect the surficial sample at this location to dig a hole approximately 10-inches deep using a stainless steel bucket auger. Decontaminate the spoon and collect soil samples from 10- to 12-inches bgs repeating Step 3 through Step 5. Immediately fill the appropriate sample containers.

8. Each sample will be located using a handheld GPS which must be set to the WGS84 coordinates using Latitude and Longitude in decimal-degree format.

9. Decontaminate the sampling equipment in accordance with procedures provided in Section 6.III.4.

**Soil – Dust Fraction**

At selected locations, a dust fraction of the soil sample will be collected and submitted separately for laboratory analysis. The dust fraction will be obtained using a 200-mesh sieve (or a larger mesh if deemed necessary by the Field Team Leader). This sampling protocol is as follows:

1. Immediately adjacent to the bulk fraction sample location, clear an area approximately 12 inches in diameter of surface vegetation and other non-representative debris.

2. Use an uncontaminated stainless steel spoon to collect the sediment to the desired depth. A stainless steel pick may be used as needed to loosen the sediment. To the extent possible, eliminate gravel or larger sized particles, vegetation or debris based on visual observation. Collect sufficient sample volume to meet analytical requirements.

3. Place the sample in a stainless steel bowl. To the extent possible, eliminate gravel or larger sized particles, vegetation or debris based on visual observation.

4. Thoroughly mix the sample material in the stainless steel bowl using a decontaminated stainless steel spoon.
5. Pass the sample through a decontaminated 200-mesh sieve (or alternate size as selected by the Field Team Leader) and collect the resulting sample in a stainless steel bowl.

6. Immediately fill the appropriate sample containers. Label and handle the containers as specified in Section 6.III.6.

7. Decontaminate the sampling equipment in accordance with procedures presented in Section 6.III.4.

Following the completion of sampling, restore the sampling location to match as closely as possible its pre-sampling condition.

Samples will be submitted under proper COC procedures for analysis of metals.

### 6.III.3 Sample Containers and Preservatives

Containers will have been cleaned and certified to be free of analytes of concern for this project. No sample containers will be reused. It will be CH2M HILL’s responsibility to obtain the appropriate sampling containers prior to sampling. Surficial soil samples will be collected in 1, 4 ounce glass bottle and 1, 8 ounce polyethylene bottle per sample at each location. The samples will be cooled by ice to 4° C immediately upon collection.

### 6.III.4 Decontamination

Sampling personnel will decontaminate sampling equipment as described below. Field and sampling equipment that may contact samples must be decontaminated after each use.

The minimum decontamination procedure for sampling equipment will consist of the following:

- Wash the equipment with non-phosphate detergent (e.g. alconox or equivalent).
- Rinse the equipment with tap water.
- Rinse the equipment with deionized/distilled water.

Equipment will be protected from dust and allowed to air dry. Decontaminated equipment will not be allowed to touch contaminated surfaces. The equipment will be labeled as decontaminated for organic sampling, with the decontamination date included on the label.

Decontamination waste media will be collected, stored and transported in approved containers.

### 6.III.5 Containment and Disposal of Investigation-Derived Waste (IDW)

In the process of collecting samples associated with the ASARCO LLC Hayden Site, the CH2M HILL sampling team will generate different types of potentially contaminated IDW that may include the following:

- Used PPE
• Disposable sampling equipment
• Decontamination fluids

The EPA’s NCP requires that management of IDW generated during sampling comply with all ARARs to the extent practicable. The sampling plan will follow the OERR Directive 9345.3-02 (May 1991), which provides the guidance for the management of IDW. In addition, other legal and practical considerations that may affect the handling of IDW will be considered.

• Used PPE and disposable equipment will be double bagged and placed in a municipal refuse dumpster. These wastes are not considered hazardous and can be sent to a municipal landfill. Any PPE and disposable equipment that is to be disposed of which can still be reused will be rendered inoperable before disposal in the refuse dumpster.

• Decontamination fluids that will be generated in the sampling event will consist of deionized water, residual contaminants, and water with non-phosphate detergent. The water (and water with detergent) will be poured into small, transportable containers.

6.III.6 Sample Management Procedures and Documentation

6.III.6.1 Field Notes

Field notes for the Site sampling activities may consist of logbooks, photographs, and COC forms.

Field Logbooks

Sampling activities will be recorded in a bound field logbook. These logbooks are intended to provide sufficient data and observations to enable participants to reconstruct events that occurred during the project, and to refresh the memory of the field personnel if called upon to give testimony during legal proceedings. In a legal proceeding, notes, if referred to, are subject to cross-examination and are admissible as evidence. Entries must be dated, legible, written in permanent ink, and contain accurate and inclusive documentation of project activities. Language should be objective and factual. Legible corrections, which will be single lines through the error, signed and dated by the person making the correction. The field logbook must be maintained by each sampling team leader to provide a daily record of significant events, observations, and measurements during field investigations. Entries should be signed and dated. It should be kept as a permanent record.

The following will be recorded in the field logbook:

• Names of sampling personnel
• Weather conditions
• Date and time of sampling
• Sample location number
• Description of sampling location (e.g., surrounding Site description and sketch, observation of staining, odors, grain-size variability, soil layering characteristics, colors, etc.)
• Soil color according to Munsel soil color chart and grain size
• Decontamination information
• Sampling method
• Sampler’s signature
• Observations of conditions that may affect sample quality

6.III.6.2 Photographs
For each photograph taken, the following information will be written in the logbook or recorded in a separate field photography log:
• Time, date, location, and weather conditions
• Description of the subject photographed
• Name of person taking the photograph

6.III.6.3 Labeling
Each sample container will be labeled with a sample identification number, date of collection, time of collection, case number if required and type of analysis. Sample identification numbers and locations (including blanks and duplicates) will be recorded in the field logbook.

6.III.6.4 Sample Chain-of-Custody (COC) Forms and Custody Seals
When samples are shipped to the laboratory, they must be placed in containers sealed with custody seals. One or more custody seals must be placed on each side of the shipping container (cooler). COC forms will be filled out or generated using Forms II Lite for the collected samples as applicable.

COC procedures will be followed as described below to accomplish this task:
• The COC documentation will be completed using the information included on each sample label including a sample identification number which will correspond to the sample site, the date and time the sample was collected, case number, the initials of the sampler, identification of any preservatives used, the sampler’s affiliation, and the analysis requested.
• Additional information included on the COC will include the contact address, phone number, and fax number of the sampler and/or consultant project manager along with any special instructions or warnings for the laboratory.
• Each COC form will be signed by the sampler and again be signed by the laboratory official once the samples have been delivered. Courier names and other pertinent information are entered in the “Received by” section of the COC record.
The COC will be included with each sample it documents until such time the samples have been delivered to the laboratory. The original COC accompanies the shipment to the laboratory. One copy of the COC will be retained in the project file, and another copy along with the archived database, will be sent to EPA.

If sent by mail, the package is registered with return requested. If sent by common carrier, a bill of lading is used. Freight bill, postal service receipts, and bills of lading are retained as part of the permanent documentation.

### 6.III.6.5 Packaging and Shipment

#### Sample Containers
- Place a custody seal around each sample container cap.
- Place sample containers in the appropriate cooler (4 ounce glass jar is to be shipped to the regional lab while the 8 ounce polyethylene jar is to be shipped to the CLP lab).
- Place sample containers in the cooler. Glass sample bottles will be covered with bubble wrap.

#### Preparing the Sample Cooler
- Remove all previous labels used on cooler.
- Seal all drain plugs (outside and inside).
- Place a cushioning layer at bottom of cooler.
- Double bag all ice in plastic bags and seal.

#### Packing Samples in Coolers
- Place COC form in Ziploc bag.
- Place samples in upright position in cooler.
- Fill void space between samples with cushioning material and/or ice.
- Place ice on top of and between samples.

#### Closing of Cooler
- Tape cooler lid with strapping tape, encircling cooler several times.
- Place COC seals on two sides of lid (suggest seal in front and side).
- Place “This Side Up” arrows on sides of cooler.

Place the coolers or box containing samples upright on a flat, stable surface to avoid tipping and/or sliding during transport. Keep out of the sun entirely. Transport to the laboratory (or an overnight courier for shipment to the contracted laboratory) immediately upon completion of sample collection. Intermediate stops should be avoided, with the exception of emergencies only, in which case the situation should be noted in the field notebooks. If the samples are shipped via overnight courier, notify the laboratory that the samples are being shipped.
6.III.7 Quality Control Samples

The QC samples will be collected or prepared to assist in determining data reliability. These QC samples include field duplicates, field blanks, and laboratory QC samples for MS and MSD. The QC samples will be collected immediately following, and using the same procedures as, the collection of the target sample.

6.III.7.1 Field Duplicates

The field duplicate is an independent sample collected as close as possible to the original sample from the same source and is used to document sampling precision. Twice the normal soil volume will be collected for field duplicate samples. Field duplicates will be labeled and packaged in the same manner as other samples so that the laboratory cannot distinguish between samples and duplicates. Field duplicates will be collected by alternately filling sample and sample duplicate containers at a location of known or suspected contamination. Each duplicate will be taken using the same sampling and preservation method as other samples. Field duplicates will be collected at a minimum frequency of one in every 10 samples. Tables 5.2-4A and 5.2-4B presents the field duplicates.

6.III.7.2 Laboratory QC Samples

Laboratory QC samples will be collected to perform MS and MSD analyses. An MS is an aliquot of a sample spiked with a known concentration of target analytes and provides a measure of the method accuracy. The MSD is a laboratory split sample of the MS, and is used to determine the precision of the method. These will be collected at a rate of one MS/MSD set per 20 samples.

Three times the normal volume will be collected for laboratory MS/MSD QC samples. Laboratory QC samples will be labeled as such on sample bottles and paperwork. Tables 5.2-4A and 5.2-4B presents the number of MS/MSDs expected to be collected during the scheduled sampling events.

6.III.7.3 Field Blanks

The field blanks are collected to verify that contamination is not introduced to samples during collection, handling, or shipping of the samples. They will be prepared by pouring blank water directly into the sample bottles (true field blanks) or by pouring blank water over or through decontaminated sampling equipment (equipment blanks). The sample bottles will consist of one 500 mL polyethylene bottle preserved with HNO₃ (pH<2) and one 100 mL polyethylene bottle preserved with either HCl (pH <2) or H₂SO₄ (pH<2). The 500 mL polyethylene bottle is to be shipped to the CLP lab while the 100 mL polyethylene bottle is to be shipped to the regional lab. Reagent-grade de-ionized water will be used for inorganic analyses using the same preservation methods and packaging and sealing procedures used during collection of samples. Field blanks will be prepared and labeled in the same manner as the field samples and sent "blind" to the laboratory. The Sample ID nomenclature will change slightly for field blank samples SPW-SED-02AB-mmddyy –(Note the “B” in place of the “S” in the Sample ID). A field blank will be collected at the last (equipment blank) sampling location each day.
6.III.7.4 Temperature Blanks

Temperature blanks will be included with each cooler shipment containing samples (regardless of targeted analysis) sent to the laboratory. A temperature blank consists of a VOC sample vial (or equivalent container) filled in the field with de-ionized water, handled like an environmental sample, and returned to the laboratory for analysis. The temperature blank provides a means of verifying that samples have been maintained at the proper temperature (4 °C) following collection and during transport to the laboratory.
6.IV  Indoor Dust Sampling

Attic and occupied area dust samples will be collected from 10 homes each in the towns of Hayden and Winkelman. The results of the dust sample analysis will reflect the long-term impacts of particulate and dust emissions to ambient air in Hayden. The results of the dust analysis will help meet the need to address indoor dust exposures of the residents of Hayden and Winkelman.

This section of the FSP provides information on field activities associated with the indoor residential sampling.

6.IV.1  Field Equipment and Measurements

6.IV.1.1 List of Equipment Needed

- Handheld vacuum cleaner
- Masking tape and marking pen
- Clean 8 ounce glass jars
- Five one-gallon bottle of reagent grade deionized water
- 20-inch-long cleaning brush
- Thermometer
- Relative humidity meter
- Nitrile gloves/work gloves
- Safety glasses/orange vests/steel toe boots
- Logbook
- Tool bag
- Paper towels
- Ziploc or similar plastic bags
- Shipping envelopes
- COC Forms
- Packaging tape, clear tape

6.IV.1.2 Sampling Location

Location of the houses will be the same as that selected for soil sampling. Ten houses in each community of Hayden and Winkelman where highest PM$_{10}$ impact is predicted by the model will be selected for sampling of indoor dust samples.

Ten (10) houses will be sampled in Winkelman and 10 houses will be sampled in the Hayden area. Seven out of 10 houses will be sampled in the areas closer to the Hayden operations where elevated soils concentrations were detected in previous investigations, while the remaining three samples will be collected in perimeter areas. One sample each will be obtained from the attic of each house (near the attic vent) and from occupied areas of the house.
6.IV.2 Sampling Procedures
Dust samples will be collected from the floors and horizontal surfaces using a handheld vacuum. For the indoor dust samples, PM is withdrawn from the carpet or other horizontal surface by means of vacuum-induced suction. A handheld vacuum will be used to collect the dust samples. Preference will be given to hard-to-reach areas (i.e., high window ledges, behind furniture) where dust often accumulates.

6.IV.2.1 Pretest Preparation and Calibration
Each vacuum filter bag to be used will be clean and visually inspected for any contamination. The vacuum bag should be marked with masking tape and a marking pen for identification of the test site, time, and date. The vacuum nozzle will be inspected to ensure that it has been cleaned and assembled properly.

6.IV.2.2 Dust Sampling Procedures
Immediately prior to testing, complete a data form recording all requested information and sketch the area to be sampled. For the indoor dust samples, select the areas in the house that have the largest amount of collected dust. These areas include behind or under furniture and appliances, window sills, and other heavy traffic areas. Place the sampler in one corner of the sampling area and vacuum the floor until sufficient amount of dust has been collected in the vacuum bag. The amount of dust collected can be estimated by visually inspecting the dust collected in the bag. The bag should be approximately one-third to two-thirds full.

Clean the nozzle lip with a clean laboratory tissue immediately before sampling. After sampling for 5 minutes, determine the amount of collected material in the bottom of the vacuum bag. If the vacuum bag is less than one-third full then sample an additional area next to the area already sampled. Hair, carpet fibers, visible paint chips and other large objects should be excluded from the sample.

Continue sampling until an adequate sample is collected. Switch off the vacuum. The vacuum bag is now removed from the vacuum, labeled, transferred to a polyethylene bottle, and capped for storage and analysis. Record the house location and area of sample on the data sheet.

6.IV.2.3 Sample Analysis
After collection of the sample in the catch bottle, the sample is transported to the laboratory in the same polyethylene bottle. Storage at ambient temperature is appropriate for samples that will be analyzed only for metals, but cooling the sample is also acceptable.

6.IV.2.4 Sampler Cleaning
After the sample vacuum bag is removed, take the sampler to a well-ventilated cleaning area free of dust. Remove the nozzle tubing from the sampler. Use a brush to clean the nozzle, and clean all related items with distilled water. Store the wash water for appropriate disposal as IDW.
6.IV.2.5 Data Analysis
The concentration of any element or chemical associated with the dust may be determined by laboratory analysis. If sufficient sample is available, use FPXRF instrument to analyze one ounce of collected sample for metals concentration.

6.IV.2.6 Labeling
Each sample will be labeled with a sample identification number, date of collection, time of collection, and type of analysis. Sample identification numbers and locations (including duplicates) will be recorded in the field notebook and field datasheet.

6.IV.3 Containment and Disposal of Investigation-Derived Waste (IDW)
In the process of collecting samples, the CH2M HILL sampling team may generate different types of potentially contaminated IDW that may include the following:

- Used PPE
- Disposable sampling equipment
- Wash from dust sampling

The EPA’s NCP requires that management of IDW generated during sampling comply with all ARARs to the extent practicable. The sampling plan will follow the OERR Directive 9345.3-02 (May 1991), which provides the guidance for the management of IDW. In addition, other legal and practical considerations that may affect the handling of IDW will be considered.

Used PPE and disposable equipment will be double-bagged and placed in a municipal refuse dumpster. These wastes are not considered hazardous and can be sent to a municipal landfill. Any PPE and disposable equipment that is to be disposed of which can still be reused will be rendered inoperable before disposal in the refuse dumpster.

6.IV.4 Sample Management Procedures and Documentation
6.IV.4.1 Field Notes
Field notes for sampling activities may consist of logbooks, preprinted field data sheets, COC, and photographs.

Field Logbooks
Sampling activities will be recorded in a bound field notebook. These notebooks are intended to provide sufficient data and observations to enable participants to reconstruct events that occurred during the project, and to refresh the memory of the field personnel if called upon to give testimony during legal proceedings. In a legal proceeding, notes, if referred to, are subject to cross-examination and are admissible as evidence. Entries must be dated, legible, written in permanent ink, and contain accurate and inclusive documentation of project activities. Language should be objective and factual. Legible corrections, which
The field notebook must be maintained by each sampling team leader to provide a daily record of significant events, observations, and measurements during field investigations. Entries should be signed and dated. It should be kept as a permanent record.

**Field Data Sheet**

The following will be recorded on the field data sheet:

- Sample location
- Names of all field team members
- Weather conditions
- Field parameters
- Time of sample collection
- Duplicates, and QA/QC samples collected
- Number of filters collected
- Laboratory the sample will be shipped to
- Comments or exceptions to the FSP/QAPP
- Reference to any photographs taken

**6.IV.4.2 Photographs**

For each photograph taken, the following information will be written in the logbook or recorded in a separate field photography log:

- Time, date, location, and weather conditions
- Description of the subject photographed
- Name of person taking the photograph

**6.IV.4.3 Labeling**

Each filter will be labeled with a sample identification number, date of collection, time of collection, the location the sample was taken from, the name of sampler, and other pertinent information. The entire sample designation will be recorded in the field notebook and field datasheet.

**6.IV.4.4 Sample Chain-of-Custody (COC) Forms and Custody Seals**

When samples are shipped to the laboratory, they must be placed in shipping envelopes and sealed with custody seals. COC forms will be filled out or generated using Forms II Lite for the collected samples as applicable.

COC procedures will be followed as described below to accomplish this task:

- The COC documentation will be completed using the information included on each sample label including a sample identification number, the date and time the sample was collected, the initials of the person collecting, and the analysis requested.
- Additional information included on the COC will include the contact address, phone number, and fax number of the collector and/or consultant project manager along with any special instructions or warnings for the laboratory.
• Each COC form will be signed by the sampler and again be signed by the laboratory official once the samples have been delivered. Courier names and other pertinent information are entered in the “Received by” section of the COC record.

• The COC will be included with each filter it documents until such time the filters have been delivered to the laboratory. The original COC accompanies the shipment to the laboratory. One copy of the COC will be retained in the project file, and another copy along with the archived database, will be sent to EPA.

If sent by mail, the package is registered with return receipt requested. If sent by common carrier, a bill of lading is used. Freight bill, postal service receipts, and bills of lading are retained as part of the permanent documentation.

6.IV.4.5 Off-site Laboratory Analysis
Samples will be sent to an off-site laboratory for evaluation. The details of the laboratory analytical procedures will be described in the project SAP.

6.IV.5 Quality Control Samples
The QC samples will be collected or prepared to assist in determining data reliability. These QC samples include field duplicates, field blanks, and laboratory QC samples for MS and MSDs. The QC samples will be collected immediately following and using the same procedures as the collection of the target sample.

6.IV.5.1 Field Duplicates
The field duplicate is an independent sample collected as close as possible to the original sample from the same source and is used to document sampling precision. Field duplicates will be labeled and packaged in the same manner as other samples so that the laboratory cannot distinguish between samples and duplicates. Field duplicates will be collected by alternately filling sample and sample duplicate containers at a location of known or suspected contamination. Each duplicate will be taken using the same sampling and preservation method as other samples. Field duplicates will be collected at a minimum frequency of one in every 10 samples. Table 5.2-5 presents the field duplicates.

6.IV.5.2 Laboratory QC Samples
Laboratory QC samples will be collected to perform MS and MSD analyses. An MS is an aliquot of a sample spiked with a known concentration of target analytes and provides a measure of the method accuracy. The MSD is a laboratory split sample of the MS, and is used to determine the precision of the method.

Twice the normal dust volume will be collected for laboratory duplicate QC samples and three times the normal volume will be collected for laboratory MS/MSD QC samples. Laboratory QC samples will be labeled as such on sample bottles and paperwork. The MS/MSDs will be collected at the discretion of the field crew, at a frequency of one in every 20 collected samples. Table 5.2-5 presents the number of MS/MSDs expected to be collected during the scheduled sampling events.
6.IV.5.3 Field Blanks
The field blanks are collected to verify that contamination is not introduced to samples during collection, handling, or shipping of the samples. They will be prepared by pouring blank water directly into the sample bottles (true field blanks) or by pouring blank water over or through decontaminated sampling equipment (equipment blanks). Reagent-grade de-ionized water will be used for inorganic analyses using the same preservation methods and packaging and sealing procedures used during collection of samples. Field blanks will be prepared and labeled in the same manner as the field samples and sent "blind" to the laboratory. A field blank may be collected at the first or last sampling location each day. Currently this is not planned for.

6.IV.5.4 Temperature Blanks
Temperature blanks will be included with each cooler shipment containing samples (regardless of targeted analysis) sent to the laboratory. A temperature blank consists of a VOC sample vial filled in the field with de-ionized water, handled like an environmental sample, and returned to the laboratory for analysis. The temperature blank provides a means of verifying that samples have been maintained at the proper temperature (4 °C) following collection and during transport to the laboratory.
6.V Attic Dust Sampling

This standard operating procedure addresses the procedures and equipment to be used for the collection of dust in the attic for metals analyses. Using very nonaggressive sampling techniques, dust is carefully collected from attic, and shipped to a laboratory in glass jars.

6.V.1 Field Equipment and Measurements

6.V.1.1 List of Equipment and Information Needed

- Building floor plan or details of attic access information
- Previous field data to properly sequence new sample and location IDs
- Blank or partially completed field data sheets and sample labels
- 8 Oz. sample bottles
- Field notebook
- Stiff clean paper
- New clean gauze or new disposable single use small paint brush with soft bristles
- Paint or marking device
- Step ladder for accessing the attic entrance
- Appropriate PPE

6.V.2 Procedure

- Initiate field logbook for sampling activity.
- Don appropriate PPE as required in the site-specific HSP.
- Assemble necessary equipment and locate the proposed sampling point(s). Sampling point is closest accessible area to outside attic vent closest to the Site operations. Sample from a single vent area is acceptable if sufficient sample volume is present, otherwise collection from more than one vent area will be needed.
- Select an approximately 1 square meter sampling area.
- Using stiff clean paper, carefully sweep or brush dust from the outside in from three sides of the square. Then sweep or brush loose material using short strokes to avoid raising dust. Avoid collecting material greater in size than 1 mm, particularly insulation, paint chips, asphalt chips or nails or wood chips. If layer of dust is more than 0.25-inch deep, then carefully stir the dust and collect an adequate sample such that representative dust is collected from top to bottom of the dust layer. Avoid sampling in an area that has been painted or contains loose chips of paint.
- Push the dust into a central pile near the fourth edge of the square. Brush onto a piece of clean stiff paper. Ensure the entire area within the square boundary is used for the dust collection. Check the accumulated material on the collection pad for larger debris and discard.
• Carefully transfer the collected dust into a laboratory-supplied clean 8 ounce bottle. The quantity of material should fill the jar at least two-thirds full.

• Prepare another sampling area if the first sampling area does not generate a sufficient quantity of dust to fill the bottle two-thirds full. Continue until the jar is sufficiently full.

• Homogenize the sample by stirring and shaking.

• Record in the field notebook the area of the attic sampled. Note the depth of dust in the area sampled.

• Where possible, paint the sample ID on the sample point.

• Discard PPE and disposable sampling equipment as specified in HASP.

• Close and secure the sampling area; leave it as you found it.

6.V.2.1 Data Analysis

The concentration of any element or chemical associated with the dust may be determined by laboratory analysis. If sufficient sample is available, use FPXRF instrument to analyze one ounce of collected sample for metals concentration.

6.V.2.2 Labeling

Each sample will be labeled with a sample identification number, date of collection, time of collection, and type of analysis. Sample identification numbers and locations (including duplicates) will be recorded in the field notebook and field data sheet.

6.V.3 Containment and Disposal of Investigation-Derived Waste (IDW)

In the process of collecting samples, the CH2M HILL sampling team may generate different types of potentially contaminated IDW that may include the following:

• Used PPE
• Disposable sampling equipment
• Wash from dust sampling

The EPA’s NCP requires that management of IDW generated during sampling comply with all ARARs to the extent practicable. The sampling plan will follow the OERR Directive 9345.3-02 (May 1991), which provides the guidance for the management of IDW. In addition, other legal and practical considerations that may affect the handling of IDW will be considered.

Used PPE and disposable equipment will be double-bagged and placed in a municipal refuse dumpster. These wastes are not considered hazardous and can be sent to a municipal landfill. Any PPE and disposable equipment that is to be disposed of which can still be reused will be rendered inoperable before disposal in the refuse dumpster.
6.V.4 Sample Management Procedures and Documentation

6.V.4.1 Field Notes
Field notes for sampling activities may consist of logbooks, preprinted field data sheets, COC forms, and photographs.

Field Logbooks
Sampling activities will be recorded in a bound field notebook. These notebooks are intended to provide sufficient data and observations to enable participants to reconstruct events that occurred during the project, and to refresh the memory of the field personnel if called upon to give testimony during legal proceedings. In a legal proceeding, notes, if referred to, are subject to cross-examination and are admissible as evidence. Entries must be dated, legible, written in permanent ink, and contain accurate and inclusive documentation of project activities. Language should be objective and factual. Legible corrections, which will be single lines through the error, signed and dated by the person making the correction. The field notebook must be maintained by each sampling team leader to provide a daily record of significant events, observations, and measurements during field investigations. Entries should be signed and dated. It should be kept as a permanent record.

Field Data Sheet
The following will be recorded on the field data sheet:

- Sample location
- Names of all field team members
- Weather conditions
- Field parameters
- Time of sample collection
- Duplicates, and QA/QC samples collected
- Number of filters collected
- Laboratory the sample will be shipped to
- Comments or exceptions to the FSP/QAPP
- Reference to any photographs taken

6.V.4.2 Photographs
For each photograph taken, the following information will be written in the logbook or recorded in a separate field photography log:

- Time, date, location, and weather conditions
- Description of the subject photographed
- Name of person taking the photograph

6.V.4.3 Labeling
Each sample bottle will be labeled with a sample identification number, date of collection, time of collection, the location the sample was taken from, the name of sampler, and other
pertinent information. The entire sample designation will be recorded in the field notebook and field datasheet.

6.V.4.4 Sample Chain-of-Custody (COC) Forms and Custody Seals

When samples are shipped to the laboratory, they must be placed in shipping envelopes and sealed with custody seals. COC forms will be filled out or generated using Forms II Lite for the collected samples as applicable.

COC procedures will be followed as described below to accomplish this task:

- The COC documentation will be completed using the information included on each sample label including a sample identification number, the date and time the sample was collected, the initials of the person collecting, and the analysis requested.

- Additional information included on the COC will include the contact address, phone number, and fax number of the collector and/or consultant project manager along with any special instructions or warnings for the laboratory.

- Each COC form will be signed by the sampler and again be signed by the laboratory official once the samples have been delivered. Courier names and other pertinent information are entered in the “Received by” section of the COC record.

- The COC will be included with each filter it documents until such time the filters have been delivered to the laboratory. The original COC accompanies the shipment to the laboratory. One copy of the COC will be retained in the project file, and another copy along with the archived database, will be sent to USEPA.

If sent by mail, the package is registered with return receipt requested. If sent by common carrier, a bill of lading is used. Freight bill, postal service receipts, and bills of lading are retained as part of the permanent documentation.

6.V.4.5 Off-site Laboratory Analysis

Samples will be sent to an offsite laboratory for evaluation. The details of the laboratory analytical procedures shall be described in the project SAP.

6.V.5 Quality Control Samples

The QC samples will be collected or prepared to assist in determining data reliability. These QC samples include field duplicates, field blanks, and laboratory QC samples for MS and MSDs. The QC samples will be collected immediately following and using the same procedures as the collection of the target sample.

6.V.5.1 Field Duplicates

The field duplicate is an independent sample collected as close as possible to the original sample from the same source and is used to document sampling precision. Field duplicates will be labeled and packaged in the same manner as other samples so that the laboratory cannot distinguish between samples and duplicates. Field duplicates will be collected by alternately filling sample and sample duplicate containers at a location of known or
suspected contamination. Each duplicate will be taken using the same sampling and preservation method as other samples. Field duplicates will be collected at a minimum frequency of one in every 10 samples. Table 5.2-5 presents the field duplicates.

6.V.5.2 Laboratory QC Samples
Laboratory QC samples will be collected to perform MS and MSD analyses. An MS is an aliquot of a sample spiked with a known concentration of target analytes and provides a measure of the method accuracy. The MSD is a laboratory split sample of the MS, and is used to determine the precision of the method.

Twice the normal dust volume will be collected for laboratory duplicate QC samples and three times the normal volume will be collected for laboratory MS/MSD QC samples. Laboratory QC samples will be labeled as such on sample bottles and paperwork. The MS/MSDs will be collected at the discretion of the field crew, at a frequency of one in every 20 collected samples. Table 5.2-5 presents the number of MS/MSDs expected to be collected during the scheduled sampling events.

6.V.5.3 Temperature Blanks
Temperature blanks will be included with each cooler shipment containing samples (regardless of targeted analysis) sent to the laboratory. A temperature blank consists of a VOC sample vial filled in the field with de-ionized water, handled like an environmental sample, and returned to the laboratory for analysis. The temperature blank provides a means of verifying that samples have been maintained at the proper temperature (4 °C) following collection and during transport to the laboratory.
6.VI Ambient Air Monitoring

6.VIA.1 Ambient Air Metals Speciation Sampling

The equipment required for the ambient air speciation for metals, the associated equipment calibrations and field measurements are described in this section.

6.VIA.1.1 List of Equipment Needed

- Two PM$_{10}$ samplers
- Two wind speed and direction measurement devices
- One Rain gauge
- PM$_{10}$ sampler calibration equipment
- Laptop/PDA with sampling software
- Connection cables
- Nitrile gloves/work gloves
- Safety glasses/orange vests/steel toe boots
- Non-serrated forceps
- Logbook
- 47 mm filters
- Filter holder cassettes
- Tool bag
- Paper towels
- Ziploc or similar plastic bags
- Shipping Envelopes
- COC Forms
- Packaging tape, clear tape

6.VIA.1.2 PM$_{10}$ Air Sampler

The mass concentration of PM$_{10}$ in the ambient air is measured by drawing air into a covered housing and flowing through a filter by means of a blower that allows suspended particulate having diameters less than 10 µm (stokes equivalent diameter) to collect on a filter surface. The filter media will be determined based on the detection limits necessary to meet the objectives of the Human Health Risk Assessment. Lower detection limits may be achieved using media other than fiberglass filters. The mass concentration of suspended particulates in the ambient air (µg/m$^3$) is computed by measuring the mass of collected particles and the volume air sampled.

The Rupperecht and Patashnick Co., Inc. (RP) Partisol-Plus Model 2025 Sequential Air Sampler is planned to be used for PM$_{10}$ sampling. The Partisol-Plus Model 2025 Sequential Air Sampler has the EPA PM$_{10}$ reference designation RFPS-1298-127.
6.VIA.1.3 Routine Maintenance and Calibration Verification

The Paristol-Plus Model 2025 (Sampler) automatically calibrates analog input and output channels. However, personnel will verify the Sampler’s flow rate performance and calibration after every four weeks of routine operation. Procedures for verification and calibration standards are outlined in the Operating Manual (RP, 1999). In addition, instrument specific operational procedures will be developed and provided in a future revision to this FSP.

Calibrations are also required on a routine basis according to EPA guidance. Calibrations will be performed at the following times:

- At the beginning of the sampling program
- A minimum of once each sampling quarter
- If the Sampler fails routine (monthly) calibration verification check
- If the Sampler is moved from one location to another
- If major repairs are necessary after a malfunction of the Sampler
- If the Sampler fails quarterly field performance audit

A label with the date when the next flow rate verification is due will be physically attached to the equipment and also entered as a reminder flag in the database. If this is not possible, records traceable to the equipment will be readily available for reference. In addition, the results of verifications, calibrations, and records of repairs will be recorded in a logbook.

Scheduled periodic calibration of equipment does not relieve field personnel of the responsibility of employing properly functioning equipment. If an individual suspects an equipment malfunction, the device shall be removed from service, tagged so that it is not inadvertently used, and the appropriate personnel notified so that a recalibration can be performed or a substitute piece of equipment can be obtained.

Equipment that fails calibration or becomes inoperable during use will be removed from service and either segregated to prevent inadvertent use or tagged to indicate it is out of calibration. Such equipment will be repaired and satisfactorily recalibrated. Equipment that cannot be repaired will be replaced.

Results of activities performed using equipment that has failed recalibration will be evaluated. If the activity results are adversely affected, the results of the evaluation will be documented, and the task manager and QA/QC reviewer will be notified.

6.VIA.1.4 Air Sampler Location

According to EPA guidelines (EPA, 1987) for PM$_{10}$ air samplers, the sample inlet for elevated source emissions monitoring must be 2 to 15 meters above ground level. When the sampler is located on a roof or other structure, there must be a minimum of 2 meters separation from walls, parapets, penthouses, etc. Regarding the surrounding area when on ground level, samplers must be placed at least 20 meters from the dripline of trees and must be 10 meters from the dripline when trees act as an obstruction. They must also be located away from obstacles such as buildings, so that the distance between obstacles and the sampler is at least twice the height that the obstacle protrudes above the sampler. The sampler must be 5 to 15 meters from the edge of the nearest traffic lane, but this would still
get impact from the roadway. There must also be unrestricted airflow in an arc of at least 270° around the sampler. Lastly, stations should not be located in unpaved areas unless there is a vegetative cover to reduce the impact of re-entrained dust.

The instrument shelters should be placed level and secure. The shelter should be sufficiently fastened to its base to avoid disturbance from high winds in the area.

6.VIA.1.5 Air Sampler Installation

Standard Hardware Configuration

The following is a list of the standard components (compilation package) provided with a Partisol-Plus Sampler:

- Partisol-Plus enclosure
- Inlet system for size-selective sampling
- Rainhoods and associated hardware
- Internal modem for remote data collection and monitoring
- Sample tube
- Partisol-Plus stand
- Ambient temperature sensor and cable
- 10 Partisol-Plus filter cassettes
- Solid filter leak check/separator disk
- 3 Filter cassette magazines
- Magazine transport container
- Flow audit adapter
- Operating software diskette
- 9-to-9 pin computer cable

Air Sampler Setup

To setup the Sampler, the following steps should be taken:

1. Remove any restraints or wraps from inside the Sampler enclosure.
2. Install the large rainhood on the right side of the enclosure. The rainhood should cover both air filters.
3. Install the two small rainhoods. Both rainhoods are installed on the back panel of the enclosure.
4. Install the sample tube and first stage inlet.
5. Connect the unit to the electric supply. Be sure to fulfill all safety and regulatory requirements for the hardware.
6. Install the ambient temperature sensor.
7. Assemble appropriate inlet for PM$_{10}$ or TSP for use.

For a more detailed description of installation and setup of the Sampler refer to the Operating Manual (RP, 1999). Furthermore, the Partisol Model 2025 Air Sampler will be
attached to a wind monitor to obtain data on wind speed and direction. The wind monitor plugs directly into the back panel of the air sampler and also allows remote controlled operations in number of ways. The air sampler can be set up so that wind monitor can trigger sampling on high wind days.

**Partisol Stand**
The Partisol stand is used to keep the inlet at the appropriate height and to provide stability for the sampler. The stand must also be properly anchored. For assembly instructions refer to the Operating Manual (RP, 1999).

**Initial Power Up**
Once the sampling system is wired to a main electrical source of the proper voltage in accordance with local standards, power can be applied to the unit. Do so by installing a loaded supply and empty storage filter cassette magazine into the filter exchange mechanism of the sampler. Press the power switch on the main panel to ON to activate the sampler. The title screen will momentarily appear. After a few seconds the main screen will display. For more details regarding navigation through the screens refer to the Operating Manual (RP, 1999).

**Software Setup and Operation**
The Sampler has six different modes: stop mode, wait mode, sampling mode, done mode, error mode, and audit mode. The user-defined system parameters can be edited with the Sampler in stop mode. However the filter cassette magazines can be swapped while the device is sampling.

The user must navigate to the Sample setup screen to define global sampling parameters for operation. These are the sample definition method (enter episodic), defaults, sample flow rate (typically 16.71/min), flow error mode, and separators. The system setup screen will display. This screen allows the user to define global parameters for the operation of the Sampler, such as current time and date, default time and date formats, and to setup the Sampler for remote operation. These parameters can be edited in the stop mode.

The Site identification screen will display. The user will identify the Site by Site Identification Number.

For more detailed information regarding software setup and operation of the Sampler refer to the Operating Manual (RP, 1999).

**6.VIA.1.6 Turning off Sampler**
When turning off the Sampler, if the device is not in the stop mode press <RUN/STOP> to enter the Stop Operating Mode. Then press the power switch on the front panel to its OFF position.
6.VIA.2 Sampling Procedures

Remote Data Collection
The samplers will be equipped with telephone modems. This will enable each sampler to be accessed remotely to download data and determine operational status. Each site will be accessed on a routine, suggested weekly basis, to determine if high-wind event sampling has been triggered so samples can be collected.

Filter Collection
Filters will be collected every two weeks or sooner if high-wind events have been sampled based on weekly remote data access. The following procedures describe installing and removing filter cassette magazines and removal of filter cassettes from the magazine. Additional instrument-specific operational procedures will be developed and provided in a future revision to this FSP.

Installing a Filter Cassette Magazine
1. Open the enclosure of the Sampler.
2. Identify the appropriate mounting position for the filter magazine to be installed (left for supply, right for storage).
3. Remove the orange cap from the top of the filter cassette magazine.
4. With the air connection of the filter cassette magazine facing toward the user, line up the grooves at the top of the filter cassette magazine with the mounting studs on the metal ring that holds the magazine in place.
5. Push the filter cassette magazine upward and rotate it to the right to lock it into place.
6. Attach the air pressure supply tube to the air connection at the base of the supply filter cassette magazine.

The piston should always be at the top of the (empty) storage magazine prior to installing the magazine into the Sampler.

Removing a Filter Cassette Magazine
1. Open the enclosure of the Sampler.
2. Rotate the magazine to the left and pull it down.
3. Place the orange cap over the open end of the filter cassette magazine to protect its contents during transport. Place the capped magazine into a metal transport container.

Removing Filter Cassettes from a Magazine
1. Remove the magazine’s cap.
2. Line up the four pins on the inner surface of the metal cap of the cassette removal sleeve with the four slots at the top of the filter cassette magazine. Slide the cassette removal sleeve onto the top of the filter cassette magazine.
3. Attach the bulb pump hose to the magazine’s air connector fitting with the quick connect fitting on the end of the hose.

4. Squeeze the bulb gently until the topmost filter cassette is positioned in the slot of the metal cap.

5. Slide the filter cassette out of the slot. Continue to push the filter cassettes into the slot by squeezing gently on the bulb. When all filter cassettes have been removed from the magazine, remove the cassette removal sleeve from the top of the magazine and disconnect the hose from the magazine air connector. The filter cassette magazine is now ready to be loaded with unused filters.

6. Insert new filter cassettes (loaded with unused filters) into the magazine one at a time, recording the serial numbers of each filter and cassette screen. Push down on each filter cassette so that the topmost filter is just below the top of the magazine. Either install the loaded magazine in the sampler, or cap the magazine to protect the filter cassettes from contamination.

For more detailed instructions regarding installation and removal refer to the Operating Manual (RP, 1999).

Post-Collection Procedure
1. Complete sampling and labeling.
2. Place filters in labeled shipping envelopes to be sent to the laboratory.
3. Follow sample documentation and shipment guidelines.
4. Follow the QC requirements.

6.VIA.2.1 Field Measurements
When field personnel replace the filters they will also connect their PC/personal digital assistant (PDA) to the Sampler and download all pertinent information. Pertinent information consists of the following: temperature, relative humidity, wind speed, and wind direction. During the collection rounds, field personnel will also record information into his/her logbook.

To collect data from the Sampler, the user accesses input and output from the system setup screen. RPComm software and a 9-to-9 pin computer cable are included with the Sampler. Together, these items enable the creation of data files containing stored information on a PC. RPComm can communicate either directly or with a modem. Refer to the Operating Manual (RP, 1999) for detailed instructions on initial setup of the Sampler and PC for downloading data.

There are three types of data stored in the unit’s internal data logger: filter data, interval data, and input data. At the start of downloading, the storage pointer needs to be set. The storage pointer is a place marker in the internal data logger. Downloading begins at this pointer and then to the last written record. For details on how to set the pointer, refer to the Operating Manual (RP, 1999). Once the pointer is set, field personnel will start downloading data from the data logger following these steps:

1. Connect PC/PDA to Sampler.
2. Ensure the storage pointer is correct.
3. Select the Download Data Tab from the 2025 main screen.
4. Select from the control buttons the desired downloading activity.
5. From the 2025 main screen select the Filter Data, Interval Data, or Input Data tab to display the desired data screen.
6. Click and drag the cursor until all the desired data is selected.
7. Click the copy icon. This will copy the selected data to the Windows clipboard and the data can then be pasted into other applications.

For more detailed information on data manipulation, storage, scheduling and advanced features please refer to the Operating Manual (RP, 1999).

6.VIA.2.2 Sample Filters
The contracted analytical laboratory or vendor will provide the required 47 mm collection filters for the cassette magazines. Filters will have been equilibrated and weighed and certified to be free of the analytes of concern for this project. No filters will be reused. It will be the field personnel’s responsibility to obtain the appropriate sampling filters prior to sampling.

6.VIA.2.3 Computation of Mass Concentration
The average mass concentration (MC) of PM$_{10}$ can be computed during the sampling period using the following formula with the information previously assembled:

$$\text{MC} = \frac{\text{DW} \times 10^6}{\text{V}}$$

where:

- DW = The net change in the mass (g) of the 47 mm filter between the initial weighing and the post-collection weighing.
- $10^6$ = Conversion factor from grams (g) to micrograms (µg).
- V = The volume drawn through the filter, as obtained from the Sampler in cubic meters (m$^3$). The Partisol-Plus Sampler can furnish either the actual or standard volume flow rate.

For 24-hour PM$_{10}$ concentration averages to be valid without adjustment for EPA reporting purposes, the total sampling time must be between 23 and 25 hours.

6.VIA.2.4 Setting up Monitor to Sample During High Wind Days
The high-wind sampling events can be set up in the Sampler using Episodic sampling setup screen. The Episodic filter setup screen provides access to additional conditional sample programming parameters. The user can select up to three conditions that must be met for sampling to take place. The unit will sample if the conditions are met, and then stop sampling and exchange a filter when those conditions are no longer met. Sampling will
begin on the new sampling filter only when conditions are again met. With Episodic sampling, there is no set sampling cycle for a given filter, rather the Sampler itself is given a duration during which the sampling on an undetermined number of filters will take place.

Set the Start Event Capture to start sampling if the wind velocity is greater than 14 miles per hour (mph). Set the Stop Event Capture to 24 hours after beginning of Episodic sampling event. For more detailed information on Episodic sampling setup please refer to the Operating Manual (RP, 1999).

A high-wind event will be determined by the wind speeds measured at each sampling station. If sustained, wind speed above 14 mph will be measured. This wind speed threshold has been selected based on past studies to determine wind speeds at which particles begin movement resulting in creation of dust from fugitive sources.
6.VII Geotechnical Evaluation

This section of the FSP provides information on procedures associated with the geotechnical evaluation of Tailings Pond AB/BC and Tailings Pond D.

The purpose of this task is to perform a reconnaissance-level general assessment of the overall stability of Tailings Piles AB/BC and Tailings Pile D. The assessment will be based on existing information and Site observations. No new Site-specific samples or data will be collected. The assessment will include a general evaluation on tailing impoundment overall stability, slope conditions, observed erosion features, and potential for additional slope erosion or failure. The assessment will also include recommendations for additional evaluation or improvements.

This general stability will be accomplished by performing the following activities:

1. **Review of Existing Information.** Review existing available information available from ASARCO and EPA for use in the stability assessment. This could include information about the materials composition, engineering properties and deposition of the tailings materials, any previous evaluation performed for the tailings impoundment, geological and geotechnical information of the soils below the impoundments, current tailings piles operations, groundwater conditions within and below the impoundments, Site topography, and surface water hydrology.

2. **Perform Site Reconnaissance.** Conduct a Site reconnaissance to observe the existing conditions of the impoundment slopes. The Site visit will include visual comparison of the existing slopes with available grading plans, observation of the general slope condition, observation of drainage features and erosion damage, and visual characterization of surface soils and slope vegetation. Information observed will be documented and photographed for use in the assessment. This task does not include any surveying of the tailings impoundment slopes, soil sample collection, or soil testing.

3. **Perform General Stability Analysis.** The overall stability of the impoundments will be assessed by performing a general stability analysis of the most critical locations identified during the Site reconnaissance. The stability analysis will be performed using the computer program Slide by Roc Science. Engineering parameters, Site geometry, and Site conditions used in the analysis will be estimated based on the data review and Site reconnaissance described above. This stability evaluation will be limited to four locations at each tailing impoundment for a total of eight cross-sections. Surface water hydraulic modeling to determine erosion effect on the tailings is not called for.

6.VII.1 Field Equipment and Measurements

6.VII.1.1 List of Equipment and Documentation Needed

The following materials and equipment may be necessary:

- Existing reports showing construction and operational details for Tailings Ponds AB/BC and D, including any existing geotechnical engineering data
• Existing detailed Site Plan (with topography) for Tailings Ponds AB/BC and D
• Existing floodplain map for the Gila River in the vicinity of the Site
• Bound field logbook
• Tape measure
• Digital camera
• GPS receiver
• Approved containers for containing soil and water
• Other materials and equipment may be needed based on field conditions

Field personnel will document the tailings pond conditions in the field logbook. Photographs should be taken at several locations to document conditions. Specifically, the following field notes will be recorded in the field book:

• Names of personnel conducting the reconnaissance
• Weather conditions
• Date and time of the reconnaissance
• Description of field conditions (e.g., surrounding Site description and sketch, observation of areas of possible instability, grain-size variability, soil layering characteristics, colors, erosional areas, etc.)
• Lead reconnaissance staff signature

6.VII.1.2 Field Measurements
This task must be performed by a qualified geotechnical engineer who is familiar with stability analysis and existing Site-specific information. The reconnaissance will be conducted at each tailings pond, focusing on areas around the perimeter of each tailings pond. The field measurements will generally consist of observations made of existing conditions. The field measurements are expected to be minimal and will consist primarily of measuring slope angle. No special calibration procedures are required.

6.VII.2 Reconnaissance Procedures
The paragraphs below describe the general procedures for the Site reconnaissance. No sampling activities are planned as part of this task.

1. Record observations separately for each tailings pond. Record all notable features, including any deviations from information included in existing reports and maps.
2. As appropriate, use the GPS receiver to document specific locations where observations are recorded.
3. When taking digital photos of up-close features, place an object of known size in the frame.
No sampling activities will be conducted; therefore detailed sampling, QA/QC, sample handling, and decontamination procedures are not described.
6.VIII Surveying and Mapping

In order to improve accuracy and efficiency and reduce the RI cost, hand-held GPS units will be utilized to establish the locations of sampling points and permanent monitoring locations including groundwater monitoring wells. These units will reduce data gaps, reduce land surveying costs, eliminate post collection data entry and data entry errors, and standardize data collection. Use of the GPS units is particularly valuable for the surficial soil, sediment, and surface water sampling efforts to be conducted over a broad area and in difficult-to-access areas. GPS units used in conjunction with the FPXRF units for soil and sediment sampling, for example, are expected to provide the real-time flexibility to focus sampling efforts as data are collected.

The GPS units will contain a form for collecting field information. The form will be established prior to initiating field work, and will have menus and check boxes for many of the fields in order to reduce data entry error and to provide data uniformity. All field technicians will receive GPS training that addresses GPS fundamentals and proper field data collection techniques.

The hand-held GPS units utilized, will be Trimble GeoXT GPS Mapping System, or a similar unit if the GeoXT is not available. This is a high-end resource grade GPS mapping system capable of collecting post processed differential GPS data with a specified accuracy of .5-meter or sub-meter root mean square (RMS), respectively. These units also employ Everest Multipath Rejection Technology, which reduces the chances of positional errors due to multipath.

The GPS units will be set to use the Trimble standard default configuration settings, which consist of a position dilution of precision (PDOP) of 6 or less, a signal to noise ratio (SNR) of 6 or more, an Elevation Mask of 15, and a logging interval of 1 second, with a 15 second minimum occupation time being collected to establish a single point feature, thus insuring synchronization of a minimum of 3 epochs with a base station operating at 5 second intervals. Caution will be taken to avoid and/or note areas where potential multipath events might occur. A real-time differential correction solution will be employed for navigation purposes utilizing the Wide Area Augmentation System (WAAS).

A post-processed differential correction procedure will be performed on all GPS data back in the office to increase the positional accuracy prior to exporting to Geographic Information System (GIS). Automated attribute settings for the export of quantitative data assessing accuracy will include PDOP, SD, Horizontal and Vertical Accuracy, Minimum Number of Positions, and the Northing, Easting, and Elevation. This information will be used in the QA/QC procedure to insure that the positional accuracy meets the required specifications of the project. All data will be exported to ArcGIS following EPA’s GIS data standards (to be determined) and will be Federal Geographic Data Committee (FGDC) compliant. Specifically, the metadata will be created using ESRI’s ArcCatalog using that program’s FGDC style sheet, which follows the FGDC’s Content Standard for Digital Geospatial Metadata (CSDGM).
6.VIII.1 Field Equipment and Measurements

6.VIII.1.1 List of Equipment and Documentation Needed

The following materials and equipment may be necessary:

- Existing detailed Site maps showing parcel identifications
- Bound field logbook
- GPS receiver
- Wooden and/or flag marking stakes
- Spray paint for marking stakes
- Surveyors marking tape
- Tape measure
- Other materials and equipment may be needed based on field conditions

Field personnel will document the parcel identification and boring locations. Specifically, the following field notes will be recorded in the field book:

- Names of personnel conducting the survey
- Sketch of parcel showing boring locations
- Coordinates of borings and wells from GPS

6.VIII.1.2 Field Measurements

This task must be performed by a person who is familiar with using the GPS instrument. The Trimble GeoXT uses TerraSync software to collect data. The TerraSync™ Operation Guide, Version 2.20, July 2002, Revision A, will be provided and referred to for collecting data. The operation guide includes a tutorial and a reference section.

6.VIII.2 Surveying Procedures

The GPS unit will be used in accordance with the manufacture’s specifications. Coordinate data will be collected at each boring location. The coordinates, parcel identity and soil boring identity will be recorded in the field logbook. A sketch of residential properties will also be included in the field logbook. Along the washes and on larger non-residential properties, the borings will be marked with either a wooden stake or flag.
6. IX  Ecological Investigation

The purpose of this task of the RI is to characterize the terrestrial and aquatic habitats in the project area. Additionally, the terrestrial and aquatic habitats in a reference area will be characterized for comparison to the study area. These characterizations in the project and reference areas will include general habitat mapping and wildlife observations, and will be conducted according to guidance for ecological assessments provided in Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessment (EPA 1997). The field equipment and measurements, as well as the field procedures for the ecological evaluations are described below.

6. IX.1  Field Equipment and Measurements

The equipment required for the ecological investigation, the calibration of this equipment, and the field measurements to be taken are described in the following subsections.

6.IX.1.1  List of Equipment Needed

The following list of equipment is needed to conduct the ecological investigation.

**Equipment for Creating the Preliminary Habitat Maps**
- High-resolution aerial photographs
- Topographic maps
- National Wetlands Inventory maps
- National Resources Conservation Service (NRCS) soil maps

**Equipment for Walking Surveys/Habitat Characterization**
- Digital camera
- Hand-held GPS unit
- Multi-meter
  - pH meter
  - DO meter
  - Conductivity meter
  - Thermometer
  - Turbidity meter
- Tape measure
- Habitat assessment forms
- Wildlife observation forms

6.IX.1.2  Calibration and Maintenance of Field Equipment

As indicated above, several instruments may be used in the field effort, including GPS and field meters (pH, conductivity, turbidity, thermometer, DO). To ensure that the instruments
are operating properly and are producing accurate and reliable data, routine calibration will be performed prior to and during use. Factory calibrations will be performed at a frequency recommended by the manufacturer. Field calibrations will be performed at least once per day, prior to instrument use. If field calibration reveals that the instrument is outside established accuracy limits, the instrument will be serviced in the field. If necessary, the instrument will be returned to the manufacturer for immediate repair and servicing. A backup instrument will be available for each of the critical real-time instruments used in the field (e.g., multi-meter for measuring pH, DO, conductivity, temperature, and turbidity).

Preventive maintenance for field equipment will be carried out in accordance with procedures and schedules outlined in the operation and maintenance handbook of a particular model. Maintenance responsibilities for field equipment are assigned to the field team leader and task leaders for specific sampling tasks. However, the field team using the equipment is responsible for checking the status of the equipment prior to use and reporting any problems encountered. The field team is also responsible for ensuring that critical spare parts are included as part of the field equipment checklist. Non-operational field equipment will be removed from service and a replacement obtained.

All field instruments will be properly protected against inclement weather conditions during the field investigation. Each instrument is specially designed to maintain its operating integrity during variable temperature ranges that are representative of ranges that will be encountered during hot or cold weather working conditions. It is recommended, but not required, that at the end of each working day, all field equipment be taken out of the field and placed in a cool, dry room for overnight storage.

6.IX.1.3 Field Measurements

Prior to beginning the field study, preliminary habitat maps will be created using existing remote sensing data (i.e., recent, high-resolution aerial photographs of the area, topographic maps, National Wetlands Inventory maps, and NRCS soil maps). The resulting habitat maps will then be verified by field surveys. Field measurements for each habitat type (terrestrial, aquatic – non-flowing systems, aquatic – flowing systems, and wetland) are outlined in the respective checklists included in the Checklist for Ecological Assessment/Sampling form from EPA (1997). This checklist is provided in Appendix A. The checklist for each habitat type will be used in the field for recording the field measurement data. A brief summary of the primary field measurements to be included in the field surveys are described below by basic habitat type.

Terrestrial Habitat Field Measurements

As part of the field survey within each delineated terrestrial habitat type at a selected location, a qualitative evaluation will be conducted. The following primary measurements for terrestrial habitats will be collected:

- Dominant plant species;
  - estimated percentage total vegetative cover
  - estimated vegetative cover height
- Any evidence of stressed vegetation (if present);
• Visual and auditory observations of wildlife species, as well as other indicators of wildlife use (e.g., burrows, tracks, scat, rubs, etc.);
• Digital photographs of each habitat type; and
• GPS coordinates of all photo-station locations for each habitat using a sub-meter accuracy GPS unit.

Additional information for terrestrial habitats will be recorded as indicated in the terrestrial habitat checklist (Section II of the Checklist for Ecological Assessment/Sampling provided in Appendix A. Examples of these additional measurements include percent cover, predominant tree size in wooded areas, average scrub/shrub height, average height of the dominant plant in open field habitat.

**Aquatic Habitat Field Measurements**

The qualitative evaluation for the aquatic habitats will include the same primary measurements as outlined above for terrestrial habitats. In addition, the following measurements specific to aquatic habitats will be recorded:

• Width and depth of water body
• pH, temperature, DO, salinity, and turbidity
• Flow velocity (if applicable)

Additional information for aquatic habitats will be recorded as indicated in the aquatic habitat checklists (Section III and IV of the Checklist for Ecological Assessment/Sampling provided in Appendix A. Examples of these additional measurements include general composition of the substrate (substrate types provided in checklist), source of water for non-flowing water bodies, and bank condition for flowing systems.

**6.IX.2 Ecological Investigation Field Procedures**

The first steps for the field survey occur prior to going into the field. These include determining the project and reference areas and creating preliminary habitat maps from aerial photographs of the project and reference areas. The procedures for these steps, along with the procedures for conducting the walking survey are described in this subsection.

**6.IX.2.1 Procedures for Determining the Project and Reference Area**

The project area was defined in the RI Workplan (CH2M HILL, 2005) using available Site information. Generally, the project area includes all terrestrial and aquatic habitat within the rectangle trending northwest-southeast and superimposed over the Gila and San Pedro River valleys as shown in Figure 6-1. The project area spans five miles on both sides of a line extending from two miles east-southeast of Winkelman to northwest of Hayden about half way to the town of Kearny. This area also incorporates the towns of Hayden and Winkelman and associated ASARCO process facilities. Because little ecological habitat is expected in these areas, field surveys will not be conducted within the towns or ASARCO facilities.
The reference area will be selected from an area with similar terrestrial and aquatic habitats as the project area, and following guidance provided in EPA, 1994 (Selecting and Using Reference Information in Superfund Ecological Risk Assessments). Potential characteristics that may be considered in the selection of reference area are described in EPA, 1992. These include physical (water, sediment, soil, and habitat structure characteristics), climatic (regional and local), and biological (community characteristics) characteristics. A summary of these potential characteristics was presented in EPA, 1994 and is duplicated in Table 6.1. These characteristics will be considered in the selection of the reference area.

### TABLE 6.1
Some Characteristics to Consider When Selecting Reference Locations

<table>
<thead>
<tr>
<th>Physical</th>
<th>Water</th>
<th>Temperature, Chemistry, Depth, Flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil</td>
<td>Particle size distribution, organic matter content, hydrologic regime, chemistry</td>
<td></td>
</tr>
<tr>
<td>Habitat Structure</td>
<td>Stream/lake bottom structure, stream/lake-side cover, vertical stratification, horizontal variation, percent cover</td>
<td></td>
</tr>
<tr>
<td>Climatic</td>
<td>Regional</td>
<td>Latitude, proximity to mountains and large water bodies</td>
</tr>
<tr>
<td>Local</td>
<td>Topography (valleys, hilltops), altitude, aspect (north- or south-facing slopes), solar radiation</td>
<td></td>
</tr>
<tr>
<td>Biological</td>
<td>Community Characteristics</td>
<td>Species abundance, species richness, diversity, trophic structure, history of species introductions</td>
</tr>
</tbody>
</table>

Notes: Table duplicated from EPA, 1997

#### 6.IX.2.2 Procedures for Creating Preliminary Habitat Maps from Aerial Photographs

Delineation of terrestrial and aquatic habitats will be based primarily on existing remote sensing data. Initial habitat delineation will be conducted using recent, high-resolution aerial photographs of the area, topographic maps, National Wetlands Inventory maps, and NRCS soil maps. Habitat types will be classified broadly into four categories: river, stable riparian, ruderal (disturbed) riparian, and upland. The initial habitat delineation will be digitized into a GIS database and mapped on high resolution aerial photograph base maps.

#### 6.IX.2.3 Procedures for Conducting the Walking Survey

Limited field surveys will be conducted to verify/ground-truth assigned terrestrial and aquatic habitat types as determined by the initial maps; to identify habitats in the vicinity of soil, sediment, and water sampling areas; and to record characteristic vegetation and general wildlife utilization patterns within the project area, as well as within a reference area (i.e., an area with similar vegetation, geology, slope, etc., but that is not impacted by the Site). Field surveys are planned to occur during the month of April, as this is a time when...
vegetation and wildlife, especially flowering plants and migrating birds, would be most abundant.

As part of the field survey within each delineated habitat type at a selected location, a qualitative evaluation will be conducted in which the dominant plant species will be identified, any evidence of stressed vegetation (if present) will be recorded, and aquatic resources will be qualitatively and quantitatively (to a limited extent) described. The data collected will be in accordance with the terrestrial and aquatic habitat checklists provided in EPA, 1997. This checklist has been reproduced in Appendix A. Photo-documentation of each habitat type will be compiled for reference and documentation of future changes or improvements in habitat quality for the Site. The photo-station locations of each habitat area will be mapped using a sub-meter accuracy GPS unit.

As previously indicated, direct observation, calls, or sign of wildlife in the project area will be recorded during the terrestrial and aquatic habitat characterization field surveys. This sampling will be incidental to the habitat characterization efforts. Observations, including species, number present, observation, and remarks/comments, will be recorded on the wildlife survey form (Table 6.2). (Note: The species observed will be recorded on the ecological assessment checklist at a later date.) Digital photos of signs will be taken and locations of direct observations and signs will be recorded in field logbooks. In addition to Site surveys, appropriate literature and database reviews and consultations with United States Fish & Wildlife Services (USFWS) and Arizona Game and Fish Department (AGFD) will be conducted to determine the existence or potential utilization of the project area by species of special status, as designated by state or federal natural resource management agencies. Specifically, AGFD will be contacted to request a query of the Natural Diversity Database prior to conducting surveys. This query would indicate any protected species known to occur in the area. Observations of any special-status species or sensitive habitat areas observed during the field surveys will be recorded using sub-meter GPS.

GPS data collected in the field will be exported into the habitat characterization GIS database for final mapping onto high resolution aerial photograph base maps. This task includes development of the initial Site map and collection of the GPS data for verifying the map. The final habitat characterization map will be developed as part of the Ecological Risk Assessment.

### 6.IX.2.4 Procedures for Photograph Documentation

Documentation of the following information will be recorded in the field notebooks for each photograph: date and time, name of the photographer, name of the site and task, general orientation and description of the subject, location of the site photograph, and photograph number.

A copy of the photographs and negatives or CD-ROM will be placed in the project file with the information outlined above.
Table 6.2 Wildlife Survey Form

<table>
<thead>
<tr>
<th>Location: ___________________________</th>
<th>Date: __________</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observer: ___________________________</td>
<td>24 Hour time: Begin: _____ End: _____</td>
</tr>
<tr>
<td>Wind (mph) __________________________</td>
<td>Temperature: Start: _____ End: _____</td>
</tr>
<tr>
<td>Clouds (%) __________________________</td>
<td>General comments:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Species</th>
<th>Number</th>
<th>Observation</th>
<th>Remarks/Behavior</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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6.IX.3 Summary of Existing Information

The Gila-San Pedro River area has been subject to considerable ecological characterization due to the presence of the southwestern willow flycatcher, a federally endangered species, in the area. The following list of flycatcher-related studies are available for use in the risk evaluations for this species:

- *Southwestern Willow Flycatcher Survey and Nest Monitoring Reports* for 2000 through 2003 (Paradzick et al., 2001; Smith et al., 2002; Smith et al., 2003; and Smith et al., 2004);
- *Southwestern Willow Flycatcher Breeding Site and Territory Summaries* for 2000 through 2002 (Sogge et al., 2001; Sogge et al., 2002; and Sogge et al., 2003);
- *Physiological Condition of Southwestern Willow Flycatchers in Native and Saltcedar Habitats* (Owen and Sogge, 2002);
- *A Quantitative Analysis of the Diet of Southwestern Willow Flycatchers in the Gila Valley, New Mexico* (DeLay et al., 2002);
- *Mapping and Monitoring Southwestern Willow Flycatcher Breeding Habitat in Arizona: A Remote Sensing Approach* (Dockens and Paradzick, 2004);
- *Banding and Population Genetics of Southwestern Willow Flycatchers in Arizona – 1997 Summary Report* (Paxton et al., 1997);
- *Food Habits of the Endangered Southwestern Willow Flycatcher* (Drost et al., 2001);
- *Survivorship and Movements of Southwestern Willow Flycatchers in Arizona – 2000* (Luff et al., 2000);
- *Survivorship and Movements of Southwestern Willow Flycatchers at Roosevelt Lake, Arizona – 2001 and 2003 reports* (Kenwood and Paxton, 2001; Newell et al., 2003);
- *Status, Ecology, and Conservation of the Southwestern Willow Flycatcher* (Finch and Stoleson, 2000);
- *Nestling sex ratio in the southwestern willow flycatcher* (Paxton et al., 2002); and
- *A multi-scaled model of southwestern willow flycatcher breeding habitat* (Hatten and Paradzick, 2003).

Additional ecological studies in the project area include a fish monitoring study being conducted by the AGFD (Voeltz, 2005), a herp (reptiles and amphibians) study being conducted by the Bureau of Reclamation (Messing, 2005), and the annual Christmas bird counts conducted in the area by the National Audubon Society (McCarthey, 2005). Brief descriptions of these three studies are provided below.

The AGFD is currently conducting a fish monitoring study that includes portions of the Gila River adjacent to and downstream of the Site and in areas within the San Pedro River (Voeltz, 2005). Two of the Gila River sites are located on ASARCO property, two are upstream of the property, two are downstream of the property, and one is upstream in the San Pedro River. This study is part of the annual sampling conducted in agreement with the
Bureau of Reclamation to monitor 22 sites in the Gila River Basin. This study does not measure contaminant levels, but provides population/community data (e.g., species abundance and richness). It should be noted that the ASARCO property sites were dry during the November 2004 sampling, as were the sites in 2003. Information on species present in past years (1999 to 2002) is available.

The Bureau of Reclamation conducted a pilot study to compare the species diversity of herps (primarily lizards, but occasionally also toads) between mature Saltcedar habitat and mature cottonwood-willow habitat in southern Arizona (Messing, 2005). The Saltcedar site is located adjacent to the San Pedro River on ASARCO property and the cottonwood-willow habitat is located near The Nature Conservancy (TNC) preserve. There are three arrays (or sampling locations within each area). An array consists of a central five-gallon bucket dug into the ground and three outer buckets about 25 feet away connected by a drift fence. The arrays were checked every other day beginning in May-September 2004. A second collection effort will be conducted May-September 2005, and some vegetation data will also be collected. If approved by EPA, ASARCO, and TNC, metals analysis of surface soil and representative herps at each array (i.e., co-located soil and biota) would provide valuable information on chemicals of potential ecological concern (COPEC) concentrations in soil and biota in these areas, as well as limited information on contaminant uptake in reptiles. Arthropods (e.g., spiders) were also observed in the pitfall traps during the pilot study. Collection and chemical analysis of these terrestrial invertebrates is also recommended.

The National Audubon Society has been conducting nationwide Christmas bird counts in December and early January for over 100 years. For the past five years, Christmas bird counts have been done in the 15-mile radius area centered at Dudleyville, Arizona (McCarthey, 2005). This area includes the towns of Hayden and Winkelman and the ASARCO LLC Hayden properties. Volunteers survey for one day and the data is compiled for the entire area. This information is useful for documenting avian species in the general project area during the winter, but may not provide information specific to the project area.

Ecological information from the available studies will be assembled, summarized, and utilized to the extent possible to augment the more limited ecological surveys to be conducted as part of this RI.

It may be possible to dispose of IDW on the ground at the Site, if this approach meets with regulatory and property owner approval. If it is decided that IDW needs to be removed from the Site, the following procedures will apply. Investigation derived waste sampling will involve collecting samples from solids (soil cuttings) and liquids (groundwater, drilling fluid-mud, and potentially water decanted from soil cuttings) derived from installing, developing and sampling six monitoring wells.

It is anticipated that during the drilling, well installation and well sampling field efforts, the solid and liquid waste streams will be segregated (e.g., using a “mud shaker” or equivalent during drilling) and containerized separately to expedite transportation to an off-Site disposal facility.

Consequently, each drill site will require sampling for each waste container type, as follows:

- Water-tight roll-off bin for soil cuttings consisting of unconsolidated silts, clays, sands, and gravels
- Water-tight roll-off bin for drilling fluid-mud consisting of groundwater, drilling fluid-mud, suspended sediment
- Polyethylene storage tank (or equivalent) for well development and purge water consisting of groundwater recovered from the well screen interval

Once each container has ceased receiving composite waste samples will be collected to accurately profile the waste for characterization and appropriate disposal.

It is anticipated that small quantities of cement grout and bentonite grout will be contained in separate drums, segregated from soil and water. These materials will not require sampling because they will not come in direct contact with Site media. Additionally, it is anticipated that used PPE and disposable equipment will be classified as non-hazardous and disposed of via double bagging and placed in a municipal refuse dumpster for disposal at a municipal landfill.

Waste storage and disposal will be coordinated with the appropriate waste management contractor to ensure compliance with applicable waste characterization, treatment, and disposal regulations. This includes performing and documenting a hazardous waste determination for each waste stream before the waste is disposed of.

The following sub-sections outline the procedures related to IDW sampling and analyses.

6.X.1 Sampling Procedures

Waste characterization of solids (soil cuttings) with roll-off bins will include the following sampling methods:
• For all sample fractions except VOCs (which will be collected as a grab sample), the soil cuttings will be composited in a stainless-steel bowl in the field by thoroughly stirring, mixing, and homogenizing the soil to provide a representative sample of the waste stream.

• The composite sample will be composed of a minimum of three subsamples of equal volume collected at various depths (using a decontaminated stainless steel hand auger or equivalent) and locations within each roll-off bin, or may consist of subsamples collected from numerous individual roll-off bins if generator knowledge can reasonably be used to infer a homogeneous distribution of target analytes within the different IDW containers.

• Samples will be collected from the stainless-steel bowl and transferred to the appropriate sample containers as specified in Table 5.2-7 for analysis of:
  - TCLP VOCs (grab sample)
  - TCLP SVOCs
  - TCLP Metals
  - Reactivity
  - Corrosivity
  - Ignitability
  - Paint Filter Test

• The COC form will denote whether a “composite” or a “grab” sample was collected.

• Samples will be preserved, labeled, and stored according to sample handling procedures cited in the QAPP.

Waste characterization of liquids/semi-solids (driving mud-fluid) from roll-off bins will include the following sampling methods:

• Samples will be composited in a dedicated half-gallon glass jar (precleaned as per EPA specifications) in the field by thoroughly stirring, mixing, and homogenizing the media to provide a representative sample of the waste stream.

• The composite sample will be composed of a minimum of three subsamples of equal volume collected at various depths (using a disposable polyethylene scoop or equivalent) and locations within each roll-off bin, or may consist of subsamples collected from numerous individual roll-off bins if generator knowledge can reasonably be used to infer a homogeneous distribution of target analytes within the different IDW containers.

• Samples will be collected from the half-gallon glass jar and transferred to the appropriate sample containers as specified in Table 5.2-7 for analysis of:
  - TCLP VOCs
  - TCLP SVOCs
  - TCLP Metals
  - Reactivity
  - Corrosivity
  - Ignitability
- Paint Filter Test

- The COC form will denote a “composite” rather than a “grab” sample was collected.

- Samples will be preserved, labeled, and stored according to sample handling procedures cited in the QAPP.

Waste characterization of liquids (groundwater) from polyethylene tanks (or equivalent) will include the following sampling methods:

- Samples will be collected using a disposable bailer lowered to the bottom of the vessel to provide a representative sample of the waste stream.

- Samples will be collected using the bailer and transferred to the appropriate sample containers as specified in Table 5.2-8 for analysis of:
  - TCL VOCs
  - TCL SVOCs
  - TAL Inorganics

- Samples will be preserved, labeled, and stored according to sample handling procedures cited in the QAPP.

### 6.X.2 Sample Containers, Preservation and Storage

The contracted analytical laboratory or vendor will provide the required sample containers for the samples. Containers will have been cleaned and certified to be free of the analytes of concern for this project. No sample containers will be reused. Preservatives, if required, will be added by CH2M HILL in the field. The adequacy of preservation will be verified by the laboratory upon receipt of the samples, and additional preservative will be added, if necessary. It will be CH2M HILL’s responsibility to obtain the appropriate sampling containers prior to sampling.

The containers, minimum sample quantities, required preservatives, and maximum holding times are shown in Tables 5.2-7 and 5.2-8.

### 6.X.2.1 Field Variances

As conditions in the field may vary, it may become necessary to implement minor modifications to sampling specifics and procedures as presented in this FSP and subsequent SAP. When appropriate, the EPA Quality Assurance Office will be notified and a verbal approval will be obtained before implementing the changes. Modifications to the approved FSP will be documented in the sampling project report.

### 6.X.2.2 Sample Document and Shipment

As conditions in the field may vary, it may become necessary to implement minor modifications to sampling specifics and procedures as presented in this FSP and subsequent SAP.
6.X.2.3 Field Notes
Field notes for Site sampling activities may consist of logbooks, pre-printed field data sheets, COC forms, and photographs.

Field Logbooks
Sampling activities will be recorded in a bound field notebook. These notebooks are intended to provide sufficient data and observations to enable participants to reconstruct events that occurred during the project, and to refresh the memory of the field personnel if called upon to give testimony during legal proceedings. In a legal proceeding, notes, if referred to, are subject to cross-examination and are admissible as evidence. Entries must be dated, legible, written in permanent ink, and contain accurate and inclusive documentation of project activities. Language should be objective and factual. Legible corrections, which will be single lines through the error, signed and dated by the person making the correction. The field notebook must be maintained by each sampling team leader to provide a daily record of significant events, observations, and measurements during field investigations. Entries should be signed and dated. It should be kept as a permanent record.

The following will be recorded on the field data sheet:

- Sample location and roll-off bin or container ID
- Names of all field team members
- Weather conditions
- Physical characteristics of the sampled media including color and odor
- Location and number of composite sample locations
- Time of sample collection
- Blanks, duplicates, and QA/QC samples collected (if any)
- Number of containers collected, preservatives used, and analyses to be performed
- Laboratory the sample will be shipped to
- Comments or exceptions to the FSP/QAPP
- Reference to any photographs taken
- Reference to any pre-printed field reference sheets

6.X.2.4 Photographs
For each photograph taken, the following information will be written in the logbook or recorded in a separate field photography log:

- Time, date, location, and weather conditions
- Description of the subject photographed
- Name of person taking the photograph

6.X.2.5 Labeling
Each sample container will be labeled with a sample identification number, date of collection, time of collection, case number if required, type of analysis, and preservatives. Sample identification numbers and locations (including blanks and duplicates) will be recorded in the field notebook and field datasheet.
6.X.2.6 Sample Chain of Custody (COC) Forms and Custody Seals

When samples are shipped to the laboratory, they must be placed in containers sealed with custody seals. One or more custody seals must be placed on each side of the shipping container (cooler). COC forms will be filled out or generated using Forms II Lite for the collected samples as applicable.

COC procedures will be followed as described below to accomplish this task:

- The COC documentation will be completed using the information included on each sample label including a sample identification number, which will correspond to the well number, the date and time the sample was collected, case number, the initials of the sampler, identification of any preservatives used, the samplers affiliation, and the analysis requested.

- Additional information included on the COC will include the contact address, phone number, and fax number of the sampler and/or consultant project manager along with any special instructions or warnings for the laboratory.

- Each COC form will be signed by the sampler and again be signed by the laboratory official once the samples have been delivered. Courier names and other pertinent information are entered in the “Received by” section of the COC record.

- The COC will be included with each sample it documents until such time the samples have been delivered to the laboratory. The original COC accompanies the shipment to the laboratory. One copy of the COC will be retained in the project file, and another copy along with the archived database, will be sent to EPA.

If sent by mail, the package is registered with return requested. If sent by common carrier, a bill of lading is used. Freight bill, postal service receipts, and bills of lading are retained as part of the permanent documentation.

6.X.2.7 Packaging and Shipment

Sample Containers

1. Place a custody seal around each sample container cap.
2. Place sample vials and bottles for each water sample in the cooler. Glass sample bottles will be covered with bubble wrap.

Preparing the Sample Cooler

1. Remove all previous labels used on cooler.
2. Seal all drain plugs (outside and inside).
3. Place a cushioning layer at bottom of cooler.
4. Double bag all ice in plastic bags and seal.

Packing Samples in Coolers

1. Place COC form in a Ziploc bag.
2. Place samples in upright position in cooler.
3. Fill void space between samples with cushioning material and/or ice.
4. Place ice on top of water samples and between samples.

**Closing of Cooler**

1. Tape cooler lid with strapping tape, encircling cooler several times.
2. Place COC seals on two sides of lid (suggest seal in front and side).
3. Place “This Side Up” arrows on sides of cooler.

Place the coolers or box containing samples upright on a flat, stable surface to avoid tipping and/or sliding during transport. Keep out of the sun entirely. Transport to the laboratory (or an overnight courier for shipment to the contracted laboratory) immediately upon completion of sample collection. Intermediate stops should be avoided, with the exception of emergencies only, in which case the situation should be noted in the field notebooks. If the samples are shipped via overnight courier, notify the laboratory that the samples are being shipped.

**6.X.3 Decontamination Procedures**

**Equipment Decontamination**

Sampling personnel will decontaminate sampling equipment as described below, unless dedicated or disposable equipment is used. Field and sampling equipment that may contact samples must be decontaminated after each use.

The minimum decontamination procedure for sampling equipment will consist of the following:

- Wash the equipment with non-phosphate detergent.
- Rinse the equipment with tap water.
- Rinse the equipment with deionized/distilled water.

Equipment will be protected from dust and allowed to air-dry. Decontaminated equipment will not be allowed to touch contaminated surfaces. The equipment will be labeled as decontaminated for organic sampling, with the decontamination date included on the label.

Decontamination waste media will be collected, stored, and transported in approved containers. They will then be characterized for disposal according to state and local regulations or combined with purge water and disposed of as a non-hazardous waste, and/or discharge to the ground surface if this is permitted for low concentration groundwater.

**6.X.3.1 Personnel Decontamination**

Procedures for personnel decontamination are discussed in Section 6 of the Health and Safety Plan.

**6.X.4 Quality Control Samples**

The only QC samples that will be collected for IDW characterization are trip blanks.

Trip blanks will be used to assess the potential introduction of contaminants from sample containers or during the transportation and storage procedures. A trip blank consists of a
VOC sample vial filled in the laboratory with HPLC-grade water, transported to the sampling site, handled like an environmental sample, and returned to the laboratory for analysis. Trip blanks are not opened in the field, are prepared only when VOC samples are collected, and analyzed only for VOCs. Trip blanks will accompany each shipment samples collected for VOC analysis.
Section 7  Health and Safety Plan

The Health and Safety Plan for the activities described in this FSP is provided in a separate document.


ASARCO, personal discussion between CH2M HILL and Jack Garrity, Technical Services Manager, during January 20, 2005 site visit.

ASARCO, personal discussion between CH2M HILL/EPA and Jack Garrity, Technical Services Manager, during December 15, 2004 site visit.


APPENDIX A—CHECKLIST FOR ECOLOGICAL ASSESSMENT/SAMPLING

Introduction

The checklist that follows provides guidance in making observations for an ecological assessment. It is not intended for limited or emergency response actions (e.g., removal of a few drums) or for purely industrial settings with no discharges. The checklist is a screening tool for preliminary site evaluation and may also be useful in planning more extensive site investigations. It must be completed as thoroughly as time allows. The results of the checklist will serve as a starting point for the collection of appropriate biological data to be used in developing a response action. It is recognized that certain questions in this checklist are not universally applicable and that site-specific conditions will influence interpretation. Therefore, a site synopsis is requested to facilitate final review of the checklist by a trained ecologist.

Checklist

The checklist has been divided into sections that correspond to data collection methods and ecosystem types. These sections are:

I. Site Description
   1A. Summary of Observations and Site Setting

II. Terrestrial Habitat Checklist
   IIA. Wooded
   IIB. Shrub/Scrub
   IIC. Open Field
   IID. Miscellaneous

III. Aquatic Habitat Checklist—Non-Flowing systems

IV. Aquatic Habitat Checklist—Flowing systems

V. Wetlands Habitat Checklist
Checklist for Ecological Assessment/Sampling

I. SITE DESCRIPTION

1. Site Name: ________________________________________________________________________________
   Location: _________________________________________________________________________________
   _________________________________________________________________________________________
   County: _____________________  City: _______________________  State: _______________________

2. Latitude: ____________________________________  Longitude ___________________________________

3. What is the approximate area of the site? ________________________________________________________

4. Is this the first site visit? □ yes □ no If no, attach trip report of previous site visit(s), if available.

5. Please attach to the checklist USGS topographic map(s) of the site, if available.

6. Are aerial or other site photographs available? □ yes □ no If yes, please attach any available photo(s) to the
   site map at the conclusion of this section.

7. The land use on the site is: The area sounding the site is:
   ___________________________________________ Mile radius
   _____% Urban
   _____% Rural
   _____% Residential
   _____% Industrial (□ light □ heavy)
   _____% Agricultural
   (Crops: ________________________________ ) (Crops: ________________________________ )
   _____% Recreational
   ___________________________________________
   ___________________________________________
   _____% Undisturbed
   _____% Other
   _____% Industrial (□ light □ heavy)
   _____% Agricultural
   (Crops: ________________________________ )
   _____% Recreational
   ___________________________________________
   ___________________________________________
   _____% Undisturbed
   _____% Other
8. Has any movement of soil taken place at the site? □ yes □ no. If yes, please identify the most likely cause of this disturbance:

   _____ Agricultural Use _____ Heavy Equipment _____ Mining
   _____ Natural Events _____ Erosion _____ Other

   Please describe: ___________________________________________
   __________________________________________________________
   __________________________________________________________
   __________________________________________________________

9. Do any potentially sensitive environmental areas exist adjacent to or in proximity to the site, e.g., Federal and State parks, National and State monuments, wetlands, prairie potholes? Remember, flood plains and wetlands are not always obvious; do not answer “no” without confirming information:

   __________________________________________________________
   __________________________________________________________
   __________________________________________________________

   Please provide the source(s) of information used to identify these sensitive areas, and indicate their general location on the site map:
   __________________________________________________________
   __________________________________________________________
   __________________________________________________________

10. What type of facility is located at the site?

    □ Chemical □ Manufacturing □ Mixing □ Waste disposal
    □ Other (specify) __________________________________________

11. What are the suspected contaminants of concern at the site? If known, what are the maximum concentrations levels?

    __________________________________________________________
    __________________________________________________________
    __________________________________________________________

12. Check any potential routes of off-site migration of contaminants observed at the site:

    □ Swales □ Depressions □ Drainage ditches
    □ Runoff □ Windblown particulates □ Vehicular traffic
    □ Other (specify) __________________________________________

13. If known, what is the approximate depth to the water table? __________________________________________
14. Is the direction of surface runoff apparent from site observations? □ yes □ no If yes, to which of the following does the surface runoff discharge: Indicate all that apply.
- □ Surface water
- □ Groundwater
- □ Sewer
- □ Collection impoundment

15. Is there a navigable waterbody or tributary to a navigable waterbody? □ yes □ no

16. Is there a waterbody anywhere on or in the vicinity of the site? If yes, also complete Section III: Aquatic Habitat Checklist—Non-Flowing Systems and/or Section IV: Aquatic Habitat Checklist—Flowing Systems.
- □ yes (approx. distance ______________________) □ no

17. Is there evidence of flooding? □ yes □ no Wetlands and flood plains are not always obvious; do not answer "no" without confirming information. If yes, complete Section V: Wetland Habitat Checklist.

18. If a field guide was used to aid any of the identifications, please provide a reference. Also, estimate the time spent identifying fauna. (Use a blank sheet if additional space is needed for text.)

_________________________________________________________________________________________
_________________________________________________________________________________________
_________________________________________________________________________________________
_________________________________________________________________________________________

19. Are any threatened and/or endangered species (plant or animal) known to inhabit the area of the site? □ yes □ no If yes, you are required to verify this information with the U.S. Fish and Wildlife Service. If species’ identities are known, please list them next.

_________________________________________________________________________________________
_________________________________________________________________________________________
_________________________________________________________________________________________
_________________________________________________________________________________________

20. Record weather conditions at the time this checklist was prepared:

DATE: _________________________________

Temperature (°C/°F) Normal daily high temperature
Wind (direction/speed) Precipitation (rain, snow)
Cloud cover
IA. SUMMARY OF OBSERVATIONS AND SITE SETTING

_________________________________________________________________________________________
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Completed by _______________________________  Affiliation _______________________________

Additional Prepared _______________________________

Site Manager _______________________________

Date _______________________________
II. TERRESTRIAL HABITAT CHECKLIST

IIA. WOODED

1. Are there any wooded areas at the site?  □ yes □ no  If no, go to Section IIB: Shrub/Scrub

2. What percentage of area of the site is wooded? (______% ______ acres). Indicate the wooded area on the site map which is attached to a copy of this checklist. Please identify what information was used to determine the wooded area of the site.

3. What is the dominant type of vegetation in the wooded area? (Circle one: Evergreen/Deciduous/Mixed) Provide a photograph, if available.

Dominant plant, if known: _____________________________________________________________________

4. What is the predominant size of the trees at the site? Use diameter at breast height.

□ 0-6 in. □ 6-12 in. □ > 12 in.

5. Specify type of understory present, if known. Provide a photograph, if available.

IIB. SHRUB/SCRUB

1. Is shrub/scrub vegetation present at the site?  □ yes □ no  If no, go to Section IIC: Open Field

2. What percentage of the site is covered by scrub/shrub vegetation? (______% ______ acres). Indicate the areas of shrub/scrub on the site map. Please identify what information was used to determine this area.

_________________________________________________________________________________________
_________________________________________________________________________________________
_________________________________________________________________________________________

3. What is the dominant type of scrub/shrub vegetation, if known? Provide a photograph, if available.

4. What is the approximate average height of the scrub/shrub vegetation?

□ 0-2 ft. □ 2-5 ft. □ > 5 ft.

5. Based on site observations, how dense is the scrub/shrub vegetation?

□ Dense □ Patchy □ Sparse
IIC. OPEN FIELD

1. Are there open (bare, barren) field areas present at the site? □ yes □ no If yes, please indicate the type below:
   □ Prairie/plains □ Savannah □ Old field □ other (specify) ______

2. What percentage of the site is open field? (_____% ______ acres). Indicate the open fields on the site map.

3. What is/are the dominant plant(s)? Provide a photograph, if available.
   ____________________________________________________________________________
   ____________________________________________________________________________
   ____________________________________________________________________________

4. What is the approximate average height of the dominant plant? ________________________________

5. Describe the vegetation cover: □ Dense □ Sparse □ Patchy

IID. MISCELLANEOUS

1. Are other types of terrestrial habitats present at the site, other than woods, scrub/shrub, and open field? □ yes □ no If yes, identify and describe them below:
   ____________________________________________________________________________
   ____________________________________________________________________________
   ____________________________________________________________________________

2. Describe the terrestrial miscellaneous habitat(s) and identify these area(s) on the site map.
   ____________________________________________________________________________
   ____________________________________________________________________________
   ____________________________________________________________________________

3. What observations, if any, were made at the site regarding the presence and/or absence of insects, fish, birds, mammals, etc.? 
   ____________________________________________________________________________
   ____________________________________________________________________________
   ____________________________________________________________________________

4. Review the questions in Section I to determine if any additional habitat checklists should be completed for this site.
III. AQUATIC HABITAT CHECKLIST—NON-FLOWING SYSTEMS

Note: Aquatic systems are often associated with wetland habitats. Please refer to Section V, Wetland Habitat Checklist.

1. What type of open-water, non-flowing system is present at the site?
   - [ ] Natural (pond, lake)
   - [ ] Artificially created (lagoon, reservoir, canal, impoundment)

2. If known, what is the name(s) of the waterbody(ies) on or adjacent to the site?
   ________________________________________________

3. If a waterbody is present, what are its known uses (e.g.: recreation, navigation, etc.)?

4. What is the approximate size of the waterbody(ies)? ____________ acre(s)

5. Is any aquatic vegetation present? [ ] yes  [ ] no  If yes, please identify the type of vegetation present if known.
   - [ ] Emergent
   - [ ] Submergent
   - [ ] Floating

6. What is the general composition of the substrate? Check all that apply.
   - [ ] Bedrock
   - [ ] Boulder (>10 in.)
   - [ ] Cobble (2.5-10 in.)
   - [ ] Gravel (0.1-2.5 in.)
   - [ ] Organic (muck, silt, detritus)
   - [ ] Other (specify) ____________________________

8. What is the source of water in the waterbody?
   - [ ] River/Stream/Creek
   - [ ] Groundwater
   - [ ] Industrial discharge
   - [ ] Surface runoff
   - [ ] Other (specify) ____________

9. Is there a discharge from the site to the waterbody? [ ] yes  [ ] no  If yes, please describe this discharge and its path.
   ________________________________________________
   ________________________________________________
   ________________________________________________
10. Is there a discharge from the waterbody?  yes no  If yes, and the information is available, identify from the list below the environment into which the waterbody discharges.

- River/Stream/Creek
  - onsite
  - offsite
  - Distance ________________

- Groundwater
  - onsite
  - offsite

- Wetland
  - onsite
  - offsite
  - Distance ________________

- Impoundment
  - onsite
  - offsite

11. Identify any field measurements and observations of water quality that were made. For those parameters for which data were collected, provide the measurement and the units of measure below:

- ______ Area
- ______ Depth (average)
- ______ Temperature (depth of the water at which the reading was taken) ______
- ______ pH
- ______ Dissolved oxygen
- ______ Salinity
- ______ Turbidity (clear, slightly turbid, turbid, opaque) (Secchi disk depth ______)
- ______ Other (specify) _______________________________________________________________________

12. Describe observed color and area of coloration.
_________________________________________________________________________________________
_________________________________________________________________________________________
_________________________________________________________________________________________
_________________________________________________________________________________________

13. Mark the open-water, non-flowing system on the site map attached to this checklist.
_________________________________________________________________________________________
_________________________________________________________________________________________
_________________________________________________________________________________________

14. What observations, if any, were made at the waterbody regarding the presence and/or absence of benthic macroinvertebrates, fish, birds, mammals, etc.?
_________________________________________________________________________________________
_________________________________________________________________________________________
_________________________________________________________________________________________
_________________________________________________________________________________________
_________________________________________________________________________________________
_________________________________________________________________________________________
IV. AQUATIC HABITAT CHECKLIST—FLOWING SYSTEMS

Note Aquatic systems are often associated with wetland habitats. Please refer to Section V, Wetland Habitat Checklist.

1. What type(s) of flowing water system(s) is(are) present at the site?
   - River
   - Stream
   - Creek
   - Dry wash
   - Arroyo
   - Brook
   - Artificially created (ditch, etc.)
   - Intermittent Stream
   - Channeling
   - Other (specify) __________________________________________________________________________

2. If known, what is the name of the waterbody? ________________________________________________

3. For natural systems, are there any indicators of physical alteration (e.g., channeling, debris, etc.)?
   - yes
   - no
   If yes, please describe indicators that were observed.
   __________________________________________________________________________________________
   __________________________________________________________________________________________
   __________________________________________________________________________________________

4. What is the general composition of the substrate? Check all that apply.
   - Bedrock
   - Sand (coarse)
   - Muck (fine/black)
   - Boulder (>10 in.)
   - Silt (fine)
   - Debris
   - Cobble (2.5-10 in.)
   - Marl (shells)
   - Detritus
   - Gravel (0.1-2.5 in.)
   - Clay (slick)
   - Concrete
   - Other (specify) __________________________________________________________________________

5. What is the condition of the bank (e.g., height, slope, extent of vegetative cover)?
   __________________________________________________________________________________________
   __________________________________________________________________________________________
   __________________________________________________________________________________________
   __________________________________________________________________________________________

6. Is the system influenced by tides?  - yes  - no
   What information was used to make this determination?
   __________________________________________________________________________________________
   __________________________________________________________________________________________
   __________________________________________________________________________________________
   __________________________________________________________________________________________
7. Is the flow intermittent?  □ yes □ no If yes, please note the information that was used in making this determination.

________________________________________________________________________________________
________________________________________________________________________________________
________________________________________________________________________________________

8. Is there a discharge from the site to the waterbody?  □ yes □ no If yes, please describe the discharge and its path.

________________________________________________________________________________________
________________________________________________________________________________________
________________________________________________________________________________________

9. Is there a discharge from the waterbody?  □ yes □ no If yes, and the information is available, please identify what the waterbody discharges to and whether the discharge is on site or off site.

________________________________________________________________________________________
________________________________________________________________________________________
________________________________________________________________________________________

10. Identify any field measurements and observations of water quality that were made. For those parameters for which data were collected, provide the measurement and the units of measure in the appropriate space below:

   ______ Width (ft.)
   ______ Depth (ft.)
   ______ Velocity (specify units): _________________________________
   ______ Temperature (depth of the water at which the reading was taken ____________________________ )
   ______ pH
   ______ Dissolved oxygen
   ______ Salinity
   ______ Turbidity (clear, slightly turbid, turbid, opaque)
       (Secchi disk depth _________________________)
   ______ Other (specify) ____________________________________________

11. Describe observed color and area of coloration.

   ______________________________________________________________________________________
   ______________________________________________________________________________________
   ______________________________________________________________________________________

12. Is any aquatic vegetation present?  □ yes □ no If yes, please identify the type of vegetation present, if known.

   □ Emergent       □ Submergent       □ Floating
13. Mark the flowing water system on the attached site map.

14. What observations were made at the waterbody regarding the presence and/or absence of benthic macroinvertebrates, fish, birds, mammals, etc.?
V. WETLAND HABITAT CHECKLIST

1. Based on observations and/or available information, are designated or known wetlands definitely present at the site? □ yes □ no

   Please note the sources of observations and information used (e.g., USGS Topographic Maps, National Wetland Inventory, Federal or State Agency, etc.) to make this determination.

_________________________________________________________________________________________
_________________________________________________________________________________________
_________________________________________________________________________________________

2. Based on the location of the site (e.g., along a waterbody, in a floodplain) and site conditions (e.g., standing water; dark, wet solid; mud cracks; debris line; water marks), are wetland habitats suspected? □ yes □ no

   If yes, proceed with the remainder of the wetland habitat identification checklist.

3. What type(s) of vegetation are present in the wetland?
   □ Submergent □ Emergent
   □ Scrub/Shrub □ Wooded
   □ Other (specify) ________________________________

4. Provide a general description of the vegetation present in and around the wetland (height, color, etc.) Provide a photograph of the known or suspected wetland, if available.

_________________________________________________________________________________________
_________________________________________________________________________________________
_________________________________________________________________________________________

5. Is standing water present? □ yes □ no

   If yes, is this water: □ Fresh □ Brackish

   What is the approximate area of the water (sq. ft.)? ________________________________

   Please complete questions 4, 11, and 12 in Checklist III – Aquatic Habitat—Non-Flowing systems.

6. Is there evidence of flooding at the site? What observations were noted?
   □ Buttressing □ Water marks □ Mud cracks
   □ Debris line □ Other (describe below)

_________________________________________________________________________________________
_________________________________________________________________________________________
_________________________________________________________________________________________

7. If known, what is the source of the water in the wetland?
   □ Stream/River/Creek/Lake/Pond □ Groundwater
   □ Flooding □ Surface Runoff
8. Is there a discharge from the site to a known or suspected wetland? □ yes □ no If yes, please describe.
________________________________________________________________________________________
________________________________________________________________________________________
________________________________________________________________________________________

9. Is there a discharge from the wetland? □ yes □ no If yes, to what waterbody is discharge released?
   □ Surface Stream/River □ Groundwater □ Lake/Pond □ Marine

10. If a soil sample was collected, describe the appearance of the soil in the wetland area. Circle or write in the best response.
    Color (blue/gray, brown, black, mottled) ____________________________________________________
    Water content (dry, wet, saturated/unsaturated) ____________________________________________

11. Mark the observed wetland area(s) on the attached site map.